DOCUMENT RESUME

ED 040 303

VT 011 399

TITLE	[Individualized Material for Industrial Education Based on the AVA Booklet "A Guide to Improving Instruction in Industrial Arts".]
INSTITUTION	Wayne State Univ., Detroit, Mich.
NOTE	1,041p.
EDRS PRICE	EDRS Price MF-$4.00 HC-$52.15
DESCRIPTORS	*Curriculum Development, Individualized Curriculum, Individualized Instruction, *Individualized Programs, *Industrial Arts, Industry, *Instructional Materials, Simulation, *Teacher Developed Materials
IDENTIFIERS	American Vocational Association, AVA, *Experienced Teacher Fellowship Program, ExTFP

ABSTRACT

This package of individualized curriculum materials for industrial arts, developed by the 1969-70 Experienced Teacher Fellowship Program for teacher and student use, is a result of an in-depth study of the 1968 revision of the American Vocational Association's booklet, "A Guide to Improving Instruction in Industrial Arts." The 10 major units included are: (1) Industry and Civilization, (2) The Industry, (3) Organization and Management, (4) Research and Development, (5) Planning for Production and Manufacturing, (6) Production and Manufacturing, (7) Distribution, (8) Service, (9) Hand Tools and Simple Machines, and (10) Sophisticated Machines. Each unit, identified by a prefix letter, contains color coded individualized packages of information for student use, teacher use, and teacher reference information which outlines special preparations or materials required for student or teacher packages. Each package within the unit is designed to be flexible for use in Grade 7 through Grade 12 and with slight modification it can be used for lower or higher grades. Several teacher-designed simulation games about industry are included. A related document is available as ED 024 814 (RIE, April 1969). (GR)

ED040303

INDIVIDUALIZED MATERIAL FOR INDUSTRIAL EDUCATION

Based on the AVA Booklet
"A GUIDE TO IMPROVING INSTRUCTION IN INDUSTRIAL ARTS"

Developed by
the
1969-70 EXPERIENCED TEACHER FELLOWSHIP PROGRAM
at
Wayne State University
Detroit, Michigan

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INTRODUCTORY MATERIALS

1. Introduction

2. Philosophy

3. Rationale

4. Goals

5. Explanation of Terms Used on Instructional Packages

6. Explanation of Numbering System and Color Code

7. Nature of the Packages
   a. Grade Levels
   b. Flexibility
      (1) Partial vs. Complete Use
      (2) Self Instruction and Group Instruction
      (3) Packages used as Resources for Teachers

8. Individual Progress

9. Use and Implementation
   a. Orientation of Students
   b. Coordination of Packages to Grade Level
   c. The Teacher as a Manager

10. Progress Report on Status of:
    a. Field Testing

INTRODUCTION

Wayne State University is an urban university located in the inner city of Detroit, Michigan. Enrollment as of September 1969 was 33,000 students. This number includes 70 percent undergraduates and a 30 percent graduate enrollment.

The 1969-70 Experienced Teacher Fellowship Program was the third and final program of this type conducted by the Department of Industrial Education at WSU. The ExTFP, as it is called, was funded through the Basic Studies Division of the Educational Professions Development Act of 1967, in cooperation with the United States Office of Education. All Fellows participating in this program fulfilled the requirements for the M.Ed. degree at Wayne State University.

The Fellowship staff consisted of: Dr. G. Harold Silvius, Director; Dr. Harold S. Resnick, Associate Director; Earl S. Mills, Industrial Coordinator and Dr. Roy W. Krause, Public School Coordinator.

The twenty-four Fellows represented eleven states and a total of more than 200 years of teaching experience. In an effort to develop curriculum materials that would be functional, the Fellows chose to conduct an in-depth study of the 1968 revision of the American Vocational Association's booklet, "A Guide to Improving Instruction in Industrial Arts." This study included a review of the stated objectives, followed by a comprehensive set of instructional "packages" designed to aid in the implementation of a curriculum established to meet these objectives. The following pages further describe this curriculum effort.

PHILOSOPHY

This curriculum is based on the belief that every individual has dignity and worth and that all individuals should receive formal educational experiences to the extent of their ability and desire. Education is a lifelong process, and a total educational experience prepares individuals not merely for a living, but for life.

Industrial Education is that phase of a total educational program dealing with modern industry and technology -- from its organization to the distribution and servicing of a product -- dealing with all occupations industrial and technical in nature. Industrial Education must also be concerned with a study of the problems related to our technological society as they affect the development of each individual in his effort to become a self-actualizing, productive member of our society.

RATIONALE

Modern industry is conceived as that institution which produces and services the material goods required by man. Modern technology is the science of the application of knowledge to practical purposes. Industry and technology, as a combined institution, have a greater impact on man than any other system in our society. Since modern industry and technology have such a great impact on the lives of men, a curriculum designed for a careful study of this institution is essential for successful preparation for life, both in terms of functioning in a technological society and in selecting an occupation within it. A broad base approach to occupational education, therefore, consists of a study at all levels of the functions and occupations related to industry and technology.

It is becoming increasingly difficult for an individual to view the totality of modern industry in operation, due to the increased specialization of the nature of occupations. In this curriculum an attempt has been made to bring industry and technology to the students in the classroom. This is accomplished through a series of simulated experiences employing the procedures of instructional technology to provide an individualized program to meet the needs of each learner.

GOALS

Following are the established goals for these curriculum materials, based on the AVA "Guide."

1. Develop an insight and understanding of industry and its place in our productive society.
2. Discover individual potentialities and aptitudes; and develop individual interests and talents, for the technical pursuits and applied sciences.
3. Develop an integration of other subject areas as they apply to the study of industry.
4. Develop techniques in the proper use of common industrial tools, machines, and processes.
5. Develop problem-solving and creative abilities involving the materials, processes, and products of industry.

EXPLANATION OF TERMS USED ON INSTRUCTIONAL PACKAGES

(Sample Package)

FOR THE STUDENT
(Specifies whether the package is to be used directly by the student, or whether the activity should be directed by the teacher, as in FOR THE TEACHER.)

No. B-52
(See Explanation of Numbering System which follows)

The Industry
(Name of the Unit this package deals with)

The Blast Furnace
(Title of this particular package)

Objective:
(This is the performance objective of the specific package stated in behavioral terms, with criteria for acceptable performance)

Prerequisite:
(This states the skills or experiences the student should have before he attempts to use this package.)

Pretest:
(This determines whether the student already has the performance as specified in the objective for the package.)

Activity:
(This section directs the student through the experiences that are suggested to attain the objective stated above.)

Post Test:
(This section is a brief evaluation instrument to determine whether the student has achieved the objective of this package.)

EXPLANATION OF NUMBERING SYSTEM AND COLOR CODE

These materials, having been developed as the companionpiece to the American Vocational Association's publication, "A Guide to Improving Industrial Arts Instruction", are divided into ten major units. The unit into which each package belongs is identified above the title to the package. The unit is also reflected in the letter preceding the number of each package. Listed below are the letters used and the unit each one represents:

A - Industry and Civilization
B - The Industry
C - Organization and Management
D - Research and Development
E - Planning for Production and Manufacturing
F - Production or Manufacturing
G - Distribution
H - Service
I - Hand Tools and Simple Machines
J - Sophisticated Machines

The Number is for identification of packages within a given unit. They do not necessarily run consecutively, nor do they imply any order or degree of difficulty.

The color of the paper indicates who the package is written for. White Paper is used for student packages, i.e., packages which may be handed to the student and provide activities for his direct participation. Yellow Paper is used for Teachers' Reference Information, which is a listing of any special materials or tools needed, or any other special arrangements needed in order for the student to complete the activity prescribed in the student package. Green Paper is used for Teacher Packages, i.e., packages which the teacher uses to conduct lectures or direct other activities which require teacher involvement.

On the following pages you will find a brief description of each unit, as written by the authors of that unit in the hope that it will give you some insight as to how they propose the material be used....

INDUSTRY AND CIVILIZATION

The idea of teaching the topic of Industry and Civilization presents a challenge to the industrial education teacher. The authors have explored many possible ways of approaching this topic in determining how to best present it to students. It is believed that there is a better method of transferring this body of knowledge than student reading or teacher lecturing.

It is not our desire to teach a long list of facts or dates, but rather to have the student develop ideas and concepts about man's evolution. It was decided that simulation games should be utilized as the media for instruction. The use of simulation games provides many opportunities for some very interesting ways of transferring ideas and concepts. Ours is a fun-loving society and students are not an exception to this thought. There are few individuals who do not enjoy participating in some form of a game. Games appeal to people of all ages and can be designed to be played with few, if any, prerequisite skills. It is, therefore, possible to have a series of games that could be used with a large cross-section of students (based upon ability as well as age.)

The playing of a simulation game can give the students many new ideas and concepts in an enjoyable manner. Learning doesn't have to be a chore or task. On the contrary, often more is learned in play than is assumed. The entire idea of activity and all its advantages to the youthful student come into play when we use the simulation game as a learning device.

It is for these reasons, and the ease of instruction and learning, that we, the authors, have designed simulation games as the media of instruction for this unit of study. These games are:

1. From the Cave to the Factory
2. The Industrial Revolution
3. The Organizing of Labor (unions) and Evolution of Automation

THE INDUSTRY

Industry is our world at work for industry is the organization that takes the raw materials and their by-products and makes them ready for use by other industries or by consumers. Those industries confined to the processing of raw materials are primary industries. Industries that take products from the primary industries and fabricate or manufacture consumer goods are secondary industries.

All industry uses energy in some form. Those packages devoted to energy are designed to teach the source of the various forms of energy, the services performed by energy, the integration of energy with other phases of industry, and the place of energy and power in our society.

The packages in this unit are of general information pertaining to the several parts of industry as they relate to our daily life. These basic packages may be used as introductions to industry and be presented in the form of films, film strips, slides, lectures, etc. Other packages providing greater depth for each area are to be used for further study and/or for individual research and study.

ORGANIZATION AND MANAGEMENT

These packages are designed to investigate the elements of industrial organization, its function, qualifications of those persons at the managerial level in industry, and to demonstrate how an industry gets started. Properly organized, these packages will become an important instrument in guiding teachers in the process of educating students in industrial functions.

An attempt is made through packages to describe the elements of managerial processes. The lessons develop a rational synthesis of the mass of details comprising the subject matter of management. The student will acquire sufficient information dealing with principles and practices of management so that he will be able to organize and carry out appropriate action. The teacher may see a need to supplement these lessons with illustrations and examples based upon his own research and experience.

Given two business firms, each having the same equipment and producing the same product at the same price, there is a possibility that one business firm will encounter a big loss. In most cases the cause is not a lack of money, but a lack of good management and organization. Management and organization are said to be the forces that put together divisions of a company, transforming it into an operating unit.

RESEARCH AND DEVELOPMENT

Research and Development, as treated here, is divided into six parts:

1. Original Concepts
2. Market Evaluation
3. Product Research and Development
4. Process Research and Development
5. Materials Research and Development
6. Market Research

Original Concepts deals with the origination of new ideas related to a product or process. These new ideas can come from several activities or sources, such as: brainstorming, accidental discovery, literature search, and need.

Market Evaluation is concerned with the potential market for a service or product.

Product Research and Development is a highly-organized function of industry which seeks out and develops profitable and useful goods. To a great extent, competition makes research and development necessary in order for a firm to remain in competition.

Process Research and Development seeks to develop better ways of producing goods or services. One example is the development of new adhesives, which has speeded up, in addition to improving, the fabrication of many products.

Materials Research and Development concentrates on the development and improvement of the materials used in manufacturing processes. Space vehicles were made possible as a result of the development of special high-strength metals and heat-resistant materials.

Market Research is the systematic, objective, and exhaustive search for and study of the facts relevant to the problems concerned with marketing a product.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

Planning for Production and Manufacturing Operations is the actual working system of an industry. It begins with the visualization of an idea, resulting in the necessary layout of men, materials, and machines needed to product a specific product.

The occupations involved in Planning for Production and Manufacturing Operations include:

Engineers	Technicians	Clerical
Plant	Time Study	Accountants
Production	Draftsmen	Data Processing
Process	Tool Design	General Office Help
	Automation	

The Unit is made up of 12 sub-sections dealing with the areas of:

Idea Visualization

Design and Preparation of Visual Information

Production Drawings

Material Specifications

Design of Tools, Jigs, Fixtures and Special Machinery

Plant Layout

Plant Organization

Estimating and Cost Accounting

Procurement and Inventory

Automation and Numerical Control

Quality and Production Control Procedures

Scheduling

PRODUCTION OR MANUFACTURING

The unit of Production or Manufacturing is primarily concerned with the methods, materials, and processes ordinarily utilized in the construction of an article.

Attention is given to the organization, training, and placement of workers to provide them with real experiences, closely related to situations in a typical industrial manufacturing or production facility.

The primary function of this unit is to organize the students, set up production and processing equipment, distribute the materials to the processing stations, perform the processes as specified by Planning for Production, controlling quality by making inspections, and finally releasing the product or part to be distributed.

In addition, several instructional packages are concerned with treatment of workers and the recognition of worker organizations, such as unions.

DISTRIBUTION

Distribution is the means by which the goods of producers or manufacturers are made available to meet consumer needs.

Distribution has been divided into four main areas through which the goods of the manufacturer are distributed to the consumer. The area of advertising shows how the medium influences the consumer. The packaging of a product for distribution shows the precautions taken to assure that the material gets to the consumer safely. Transportation takes the material from the manufacturer through various means to the area of marketing where, through the wholesaler and retailer, it is sold to the ultimate customer.

SERVICE

The purpose of the Service Unit is to investigate the various service occupations that deal specifically with the servicing of industrial production equipment and the consumer products they produce. The packages developed comprise the following categories:

1. Diagnosing the situation through a logical sequence to identify the components in need of maintenance, repair, or replacement. The key items to be considered under the diagnostic category are analysis and diagnosis; troubleshooting; test equipment applications, and preventive maintenance.

2. Correcting the malfunctions identified by the diagnostic procedure in order to obtain further useful service from that product

or equipment. The key items to be considered under the corrective category are removal and replacement; repair; reading of manuals, blueprints, and schematic diagrams; and the application of tools and equipment.

3. Testing to make certain that both the diagnostic and corrective functions were successful and that further corrections and maintenance are unnecessary. The key items to be considered under the testing category are use of instruments; methods of testing; procedures for testing, and specific tests.

HAND TOOLS AND SIMPLE MACHINES

The objectives for this unit are two: 1) to provide the teacher with sources of or self-instructional material related to the identification and application of common hand and machine tool techniques, and 2) to provide the resource material related to the manipulative activities to reinforce the other units. It is not the intent of this unit to replace the teacher, but rather to better prepare the student for the task.

The manipulative and cognitive activities of the same general problem - e.g., identification of tools - have been approached with several instructional formats. The teacher can then choose which format best meets the needs of his student. At that point, revision of other packages would be recommended.

Some packages call for a teacher assistant. This format was chosen to involve other students in a teaching experience. If a student can teach a body of knowledge to another student, then he must know it. Though the teacher assistant can be anyone, it is recommended he be a member of the student peer group.

Commercially available 8mm. single concept loop films are being produced in increasingly large numbers. At the time of the development of these materials, only a small amount were available for purchase and a lesser amount for review purposes. It is suggested that the teacher keep abreast of new media commercially produced in order to keep this section relevant.

SOPHISTICATED MACHINES

It is intended that the instructional materials contained in this area be self instructional in nature.

The field of "energy and propulsion systems", as it relates to industry, is extremely large. The machines or systems contained under this title affect virtually all phases of product manufacture maintenance, including planning, packaging, marketing, etc. Some of these are the fluid and electrical power systems that propel "materials and processes" machines. Other areas provide the instrumentation, guidance, and control for these machines. From these few examples, the scope of the field is readily sensed. The "E&P" area introduces the student to some of the machines used in electronic instrumentation. The instruments covered are those generally available in the classroom.

Each machine has a package describing its basic components, a safety test, related information, teacher demonstration, and a student lab sheet to use while operating the machine. The packages are broad in scope in that little emphasis is placed on detail. This is intentional, because of the variety of different designs of similar machines on the market. If the packages covered a particular model of machine, they would be useless if a shop did not have the model of machine in the package. These packages should be used by a teacher who has a knowledge of the machines.

NATURE OF THE PACKAGES

Grade Levels. The packages have been designed so that they may be used within a total curriculum encompassing seventh through twelfth grades. Certain sections may be used as an introduction to the study of industry in the elementary grades. They may serve as an introduction to certain sections of industry at the higher levels, or as a complete study of a section of industry in the lower grades. We have developed the packages of instruction so the student may progress at his own ability.

Flexibility. These packages are designed to make a flexible approach available to the teaching of industrial education. The individual teacher determines the course content by the packages he chooses to use, reflecting the needs dictated by the geographical location in which the class is being taught. The selection of packages also provides flexibility and adaptability to any subject area in industrial education.

These materials can be used for implementation of a total program. One might utilize some selected packages from each unit, and with the establishment of a company, provide the students with an exposure to all the operations that take place in industry, from organization and management to the servicing of final products. It should be noted here that students can work in those areas in which they have greater interest and each individual need not progress through the same identical activities. For example: a student with an interest in Research and Development could concentrate his efforts in that area; however, he would acquire an exposure to the overall operation of industry as he makes his personal contribution to the operation of the company.

The activity just described need not represent the total activity for any given course. Concomitant activities for the course might include individual or class projects. In this case, selected packages could provide reference and guidance to individual students. The use of packages to supply information and direction to the student can help to free the teacher from menial tasks that consume so much time.

While this approach toward teaching industrial education lends itself toward providing students with an overall view of industry, any teacher could certainly adopt individual packages that might be used to meet his course objectives. For instance, packages dealing with tools and machines might be selected to give students the skills needed to perform required laboratory activities. Another application could utilize packages from one area, such as service, where the goal might be to expose the students to a variety of service procedures or occupations.

Regardless of the approach, these packages do provide for a number of needs from the implementation of a total program to the implementation of a partial program where packages function as an aid to the instructor.

Three types of information are provided by these packages. First, student packages contain a direct assignment to the student. (Note: Teacher preparation may be required to make tools, materials or films needed by the students available for completion of these packages.) Second, teacher packages provide direction to the teacher for an activity requiring teacher participation. The teacher involvement may vary from class discussion to organization of a student committee, or the directing of an activity using the information provided. Third, teacher reference information outlines special preparations or materials required for either student or teacher packages.

Students can be given assignments on an individual or small-group basis without the need for the involvement of the entire class. This means that the student will not have to sit through lectures or discussions not pertinent to his needs or activities. Each individual student would be able to progress at his own rate, limited not by the ability of the class, but only by his own interest and ability.

Individual packages have not been structured into a formalized curriculum because a specific program would have reduced the flexibility already mentioned and would make updating or modification difficult. Teachers can use the flexibility and resources obtained in these packages in the following ways: first, to develop new packages using the ideas acquired from the packages already developed; or second, by utilizing the basic resources of packages already developed, a teacher may adapt an existing package to meet the specific needs of his course.

INDIVIDUAL PROGRESS

An examination of the packages show that the majority of the packages are entitled "For the Student". This designation means, in most cases, that the package can be given directly to the student. He should then be able to perform the activities described in the package on his own.

The use of individualized instruction wherever possible has a great number of advantages. Certain types of materials, however, do not lend themselves well to individualized instruction. The Project has recognized this, and has designed teacher packages for those areas of instruction.

One of the more important advantages of the individualized instruction plan is that it allows for individual progress. How often have teachers set up a learning activity only to find that some of the students are finished while the majority are still occupied with the challenge of the activity? Educators have found it disastrous to expect these more capable students to bide their time with "busy work" until the others catch up. Of course, there is the common escape of having the advanced student lead and assist the slower ones. This method, although better than the first, where time is being wasted, still does not take full advantage of the individual's efforts, abilities, and time. In the past we have lost a great number of our more advanced students for lack of imagination in creating instruction that allows for individual progress.

USE AND IMPLEMENTATION

Orientation of Students. The concept of individualized instruction has been discussed in detail. This type of instruction leads to a different teaching-learning situation. It must be assumed that the student will not be accustomed to this method of instruction and thus should be given a thorough orientation concerning the use, format, and implementation of these packages.

In the field testing of student packages, it was found that the students at first had difficulty in working with the packages. They had not been previously oriented for individualized instruction. They were not accustomed to taking the initiative necessary to forge ahead without direct contact with the instructor. They were reluctant to follow written instructions on the packages without the verbal reassurance of the instructor in charge. It took some time before the test students broke the bands of traditional education methods and felt free to perform without direct teacher supervision. When the students did finally acquire the confidence to work alone, things began to move very smoothly.

It is most necessary, therefore, for the instructor to set the mood (stage) for individual instruction. The student must be exposed to an extensive orientation not just to the curriculum of the program, but also to the mechanics of its operation. It is much like learning how to drive with a manual shift and then getting into an automatic shift car. It takes time to get accustomed to the new way of performing.

Coordination of Packages to Grade Level. It should be recognized after looking at the packages that any given package would not apply to all grade levels. An attempt has been made to prepare materials that could be used in a great number of different situations. In some cases the instructor may find it necessary to adapt the existing package to match the level of the students with which it is to be used.

No attempt has been made to label the packages according to individual grades because of the many variables in different school situations. The individual instructor must be the one to make the judgment as to which packages can be successfully used in his particular situation. In some cases, perhaps, just a few words of instruction are necessary to make a package applicable. Regardless, the original package should provide an excellent stepping-stone toward developing your own materials.

The Teacher as a Manager. A person who controls, directs, conducts, guides, and administers is called a manager. The teacher who hopes to use these materials in an effective, efficient way must perform these functions. This program was not designed to replace the teacher or place him in a secondary role. To the contrary, it will take a great amount of effort on the part of the instructor to make this program successful. It is hoped that these curriculum materials will make it easier for the teacher to have a program that will be more meaningful for the industrial arts student.

The teacher will find himself very busy in this situation. He will need to exert a new kind of effort in order for this material to work successfully. The level of effort put forth by the instructor will determine the amount of success enjoyed by the program.

It is recognized that the mere upkeep of the packages themselves will be a job requiring some attention. The best way to keep the packages in order would be to set up a file drawer with the original copies. Never allow the original packages to be used by the students. If the original is lost, you will experience some problem in replacing it. It is suggested that the originals be kept in a file set up according to the ten major units. As the need for use arrives, the teacher can draw the original from the file and duplicate copies for student use.

Certain packages will require specific materials. It will take the teacher time and preparation to gather all of these materials. Once they are first assembled, it is suggested that a storage system be established where the student could secure these specific supplies without asking the teacher to provide them. Without this system, the teacher will face as many problems the second time the program is run as he did the first.

The method of storing the hardware and making it readily available to the students with a minimum amount of involvement by the teacher can accomplished in different ways. The method you choose will, of course, be determined by your own personal situation and preferences. What is important is the realization that a system of hardware control must be established to make sure the primary effort applied the first time is not duplicated each time the program is run.

FIELD TESTING

A proposal pertaining to the field testing of these materials is currently being written. For additional information concerning Individualized Material for Industrial Education please contact:

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INDIVIDUALIZED MATERIALS FOR INDUSTRIAL EDUCATION

LIST OF PACKAGES

UNIT A - INDUSTRY AND CIVILIZATION

A-1 From The Cave To The Factory

A-2 The Industrial Revolution

A-3 Americam Enterprise Game
[Automation, Management, and Labor Unions]

UNIT B - THE INDUSTRY

B-30 The Uses Of Lumber In The Building Trade

B-31 Advantages Of Lumber In The Construction Industry

B-32 Classification For Construction Lumber

B-33 Load Capacity Of Lumber

B-39 Job Opportunity In The Construction Fields

B-40 Other Industries Related To Lumber

B-41 The Making Of Paper

B-42 The Furniture Industry

B-43 By-Products Of Wood

B-46 The Making Of Particle Board

B-50 The Story Of Iron And Steel

B-51 Ingredients Of Iron And Steel

B-52 The Blast Furnace

B-53 Methods Of Making Steel

B-54 The Rolling Mill

B-59 Career Opportunities In Iron And Steel

UNIT B - THE INDUSTRY

B-60 The Story Of Copper
B-61 Working With Copper
B-70 The Story Of Aluminum
B-71 Sources Of Aluminum
B-72 How Aluminum Is Made
B-73 How Aluminum Is Shaped
B-74 Finishes And Coatings For Aluminum
B-75 Advantages Of Using Aluminum
B-79 Careers In The Aluminum Industry
B-80 The Foundry Industry
B-81 History Of The Foundry Industry
B-82 Sand Casting
B-83 Other Molding Processes
B-89 Careers In The Foundry Industry
B-90 Powered Metallurgy
B-91 Manufacture Of Metal Powders
B-92 Applications Of Powered Metallurgy
B-101 Composition Of Plastics
B-102 Properties Of Plastics
B-103 Processing Plastics
B-109 Opportunities In The Field Of Plastics
B-110 The Uses Of Plastics In The HOme
B-111 The Uses Of Plastics In Industry
B-120 Careers In Industry
B-121 Skilled And Technical Occupations In Industry

UNIT C - ORGANIZATION AND MANAGEMENT

C-10 Delegating Authority And Responsibility

C-11 Selecting Executive Talent

C-12 Organization Processes: Coorination

C-13 Duties And Responsibilities Of Personal Administration

C-14 Factors Affecting Industry

C-15 Master Plan For The Development Of Personal Activities

C-16 Designing A Job Description Survey

C-16 Policy Formulation For A Company

C-17 Selecting An Educational Director

C-18 Duties Of The Safety Director

C-19 Preparing Application Blanks

C-20 Organization Design For A Student Cooperation Showing It's Major Subdivisions And Functions Of Each

C-21 Structural Relationship Of The Organizational Departments

C-22 A Typical Research And Development Department Showing It's Subdivisions And Functions

C-23 A Typical Engineering Department Showing It's Subdivisions And Functions

C-24 A Typical Production Depatment Showing It's Subdivisions And Functions

C-25 A Typical Distribution Or Sales Department Showing It's Subdivisions And Functions

C-26 A Typical Record-Keeping Department Showing It's Subdivisions And Functions

C-27 A Typical Service Department Showing It's Subdivisions And Functions

C-28 A Typical Personnel Department Showing It's Subdivisions And Functions

C-29 The Initial Start Of A Student Corporation

UNIT D - RESEARCH AND DEVELOPMENT

D-1 Learning About Research And Development

D-3 Having A Brain Storming Session

D-3 Evaluating Possible Products

D-4 Selecting The Product

D-5 Presenting The Product

D-6 Studying Competitive Products

D-7 Determing The Size Of Possible Market

D-8 Researching The Patent Law For Your Product

D-9 Investigating Federal, State And Local Restrictions That May Affect The Manufacturing Of Your Product

D-11 Studying Functional Requirements

D-12 Determining Material Requirements

D-13 Determining Visual Requirements

D-15 Finding The Cost Of Production

D-16 Correcting Product Deficiencies

D-17 Selecting The Best Processes

D-18 Determining The Procedures In Making Your Product

D-20 Choosing New Processes

D-21 Correcting The Processes Chosen

D-22 Determining Possible Materials

D-23 Testing The Materials

D-24 Finding The Properties Of Materials

D-25 Tests For Finding The Properties Of Materials [Hardness And Toughness]

D-26 Tests For Finding The Properties Of Materials [Workability]

D-27 Tests For Finding The Properties Of Material [Strength]

UNIT D - RESEARCH AND DEVELOPMENT

D-28 Tests For Finding The Properties Of Materials [Wear Or Decay]

D-29 Tests For Finding The Properties Of Materials [Compression]

D-30 Considering The Cost Of Materials

D-31 Determining The Availability Of Materials

D-32 Selecting Best Materials

D-33 Correcting The Materials Chosen

D-34 Conducting Market Research

D-35 Designing A Consumer Analysis Form

D-36 Designing A Market Survey

D-37 Gathering Consumer Suggestions

D-38 Analyzing Competition

D-39 Determing Pricing Effects

D-40 Collecting Data For Sales Analying

D-41 Presenting The Results Of Market Research To The Entire Corporation

UNIT E - PLANNING FOR PRODUCTION AND MANUFACTURING

E-1 Exploring The Field Of Engineering

E-2 Using Design Practices As A Design Engineer

E-4 Making A Rough Sketch Of An Idea

E-5 Building A Model Of A Product

E-6 Building A Full-Size Mock-Up

E-7 Building The Prototype

E-8 Th- Product Engineer

UNIT E - PLANNING FOR PRODUCTION AND MANUFACTURING

E-9 Making A Layout

E-10 Making Requests To Research And Development

E-11 Drafting Tools

E-12 The Draftman And His Duties

E-13 Making A Production Drawing

E-14 Essential Drawing Information

E-15 Checking The Drawing

E-17 Drawing Reproduction

E-18 Notes Found On Blueprints

E-25 Designing A Drill Jig

E-26 The Jobs Of Tool And Die Makers:
Fabricating Jigs, Fixtures, And Dies

E-27 Identifying General Purpose And Special Machinery

E-31 Estimate The Labor Cost Of One Operation
On The Drill Press

E-33 Estimate The Cost Of One On The Scroll Saw

E-34 Estimate The Labor Cost Of One Operation
On The Buffer

E-35 Estimate The Labor Cost Of Smoothing The Edges
Of A Piece Of Sheet Metal With A File

E-36 Estimate The Labor Cost Of One Operation
On The Sheet Metal Brake

E-40 Estimate The Cost Of Material To Produce One Single
Unit Or All Units Of A Production Production

E-41 Estimate The Total Cost Of Producing One Unit
Or All Of The Units Of A Production Product

E-42 Fill Out A Request For Quotation Form

E-43 Fill Out A Purchase Order

E-45 Design A Traffic Route For Materials Entering A Plant
[School Shop], And Routes For This Material To Reach
A Point Where It Will Be Used

UNIT E - PLANNING FOR PRODUCTION AND MANUFACTURING

E-46 Alphabet Of Lines

E-53 Defining Automation

E-54 Defining Numerical Control

E-56 Working With Punch Cards

E-58 Making A Time-Keeping Record

E-59 Using A Schedule Board

E-61 Testing Assembled Products

E-62 Analyzing Production Problems

E-63 Developing A Route Sheet

E-100 Transfer From Full Scale To 1/4" Scale

E-101 Floor Plan Of A Production Area

E-102 Movable Furniture And Machine Templates

E-103 Latout Of A Flow Chart

E-104 Layout For A Master Floor Plan

E-109 Suggested Activities

E-111 Determining Safety Standards For Manufacturing

E-112 Types Of Fires And Firefighting Equipment Common To Industry

E-120 Where To Locate A Factory

UNIT F - PRODUCTION OR MANUFACTURING

F-1 The Student Will Select A Production Supervisor

F-2 Duties And Responsibilities Of The Shop Foreman

F-3 The Students Will Select A Production Safety Engineer

F-4 Selecting A Shop Steward

F-5 The Student Will Fill Out Job Applications

UNIT F - PRODUCTION OR MANUFACTURING

F-7 Establishing A Training Program

F-8 The Foreman Will Interview Job Applicants

F-8 Placement Of Workers On A Production Line

F-9 Production Or Manufacturing Systems

F-10 Safety Inspection

F-11 The Student Will Select The Methods Of Training Needed In The Production Of A Product

F-12 Training The Production Line Worker

F-13 Determining Handling And Transfer Time

F-14 Troubleshooting And Performing Minor Electrical Repairs

F-15 Determining Waste In Production

F-16 Taking Inventory

F-17 Ordering Supplies From Stores

F-18 Receive And Store Supplies

F-19 Maintaining Stores Records

F-20 Providing Supplies On The Production Line

F-21 Preparing A Process Progress Record

F-22 Quality Control

F-23 A Check List Of Production Materials

F-24 Parts And Product Inspection

F-25 Developing A Check-Off Sheet

F-26 Performing Preventive Maintenance On Electrical Systems

F-27 Performing Preventive Maintenance On Fluid Power Systems

F-28 Troubleshooting And Performing Minor Fluid Power System Repairs

F-30 Preventative Maintenance-Lubrication

F-31 Closing Down The Production Line

F-33 Transfering Completed Products To Storage

UNIT F - PRODUCTION OR MANUFACTURING

F-34 Preparation For Start-Up

F-35 Determining Man-Hour Waste

F-36 Tool Inventory

F-37 Equipment Inventory

F-39 Depreciation

F-40 Alternatives For A Cleaner Environment

F-41 Cleaning The Air

F-42 Getting Rid Of Solid Waste

F-43 Suggestions

UNIT G - DISTRIBUTION

G-1 Shall We Advertise?

G-2 Creating An Advertising Agency

G-3 Designing An Ad For A Student Newspaper

G-4 What Kind Of Advertising Shall We Use?

G-5 How Much Shall We Spend On Advertising?

G-6 Cutting A Linoleum Block

G-7 Develop A Flyer To Be Printed And Distributed

G-9 Design A Poster For The School Bulletin Board

G-11 Preparing A Radio Announcement

G-12 What Is The Purpose Of Packaging A Product?

G-13 Examine Some Packages That Are Similar To The Products We Are Packaging

G-14 Types Of Material Available For Packaging

G-17 Subcontracting The Packaging Operation

UNIT G - DISTRIBUTION

G-19 How Goods Get From The Manufacturer To The Consumer A General Introduction

G-20 The Role That Transportation Plays In The Distribution Of Goods

G-21 Factors That Help A Company Choose A Method For Transporting Goods

G-23 The Need For Storing Goods

G-24 Storing Your Materials And Products

G-25 The Marketing Channels Of Distribution

G-26 Marketing Functions

G-27 Types Of Marketable Goods

G-28 Middlemen Methods Of Determining Prices Of Goods

G-29 Middlemen Buying And Selling Policies

G-30 Determining The Prices Of Your Product

G-32 Developing An Order Blank

G-33 Filling Out An Order Form

G-34 Taking Orders

G-35 Delivering The Product And Collecting The Money

G-36 An Introduction To Market Finance

G-37 Preparing For A Field Trip To A Bank

G-60 The Functions Of The Copy Department

G-64 Cutting A Stencil For A Poster

G-65 Preparing The Stencil For Printing

G-66 Printing The Poster For A Bulletin Board With A Silk Screen

UNIT H - SERVICE

H-1 How To Conduct An Automobile And Truck Safety Inspection

H-1 The Application Of The Battery Hydrometer

H-6 Aeronautical Service Problem

H-6 The Painter

H-7 The Servicing Of Transistors By Using A Crystal Set [Radio] For A Demonstrator

H-8 Problem Solving - Small Gasoline Engines [2 Cycle]

H-9 Trouble Shooting - Testing - Two-Cycle

H-10 Identifying Fluid Power Technician Work Duties And Capabilities

H-11 Hardware Store Sales

H-12 Automobile Lubrication And Fluid Capacity Guide

H-13 Replacing A Front Wheel-Inner Grease Seal

H-15 Replacing A Light Switch

H-15 Design Your Own Service Garage

H-19 Compression Testing Of An Automobile Engine

H-20 Ignition Breaker Point Removal And Replacement-Adjusting Cam Dwell Angle

H-21 Breaking Cylinder Wall Glaze And Clean-Up Procedure

H-22 Wheel Alignment Correction

H-23 Plumbing: Use Of Copper Tubing And Fittings To Demonstrate Industrial Uses

H-24 Fuel Pump Removal And Replacement

H-25 Starter Free-Running Torque Test

H-26 Preparing Repair Orders

H-30 The Plumber - Threading Pipe

H-31 Preparing Tubing For Fittings

H-32 Repair Or Replacement Of Metal Tubing Using A Flare Fitting

H-32 The Plumber: Making A Cast Iron-Pipe Joint

UNIT H - SERVICE

H-33 Repair Or Replacement Of Metal Tubing With Flexible Hose And Clamp

H-34 Inspecting And Bleeding Hydraulic Brakes

H-35 Identification Of Lubricants

H-36 Identification Of Oil By Service Rating And Viscosity

H-37 Lubricating Machines And Equipment

H-38 Electrical Repair[Wiring An Attachment Plug]

H-39 Electrical Repair[Replacing A Single Pole Light Switch]

H-40 Reading Electrical Schematic Diagrams

H-41 Reading Parts Book

H-42 Reading A Micrometer

H-43 Reading Two And Three View Drawings

H-44 Use Of A Micrometer

H-45 Crankshaft Inspection

H-46 Bearing Failure Analysis

Hi47 Battery Capacity Test

H-48 Exposure To A Job

H-49 Testing Welds

H-50 Reading A Tap Drill Chart

UNIT I - HAND TOOLS AND SIMPLE MACHINES

I-5 Making Angular Cuts With A Mitre Box

I-6 Hand Saw Usage

I-8 Positioning Work

I-9 Selecting Tools

I-11 Boring Tools Identification

I-12 Boring Cutting Tools Identification

UNIT I - HAND TOOLS AND SIMPLE MACHINES

I-16 Drilling

I-20 Metalworking Punches Identification

I-29 Power Hand Tools Identification

I-46 Hammers Identification

I-58 Planes Identification

I-59 Cutting With A Plane

I-61 Finishing Identification

I-62 Preparing Surfaces

I-63 Painting

I-64 Finishing

I-67 Joining Two Pieces Of Metal Together By Hand Riveting

I-69 Fastening Sheet Metal Using A Pop Riveter

I-80 Positioning Work For The Band Saw

I-81 Positionong Work For The Circular Saw

I-85 Using A Die To Thread A Rod Or Pipe

I-87 Making Internal Threads With A Hand Tap

I-88 Removing A Broken Bolt From A Hole With A Screw Extractor

I-90 Remove A Broken Tap With A Tap Extractor

I-93 Sheet Metal Hand Snips Identification

I-94 Cutting Sheet Metal With Hand Snips

I-100 Bending Sheetmetal Using The Bar Folder

I-101 Sheet Metal Stakes

I-102 Bending Sheet Metal On The Box And Pan Brake

I-104 Making A Grooved Seam With A Hand Groover

I-105 Bending An Edge Or Folding A Hem Using The Hand Seamer

I-108 Cutting Band Iron Using The Bench Shear

UNIT I - HAND TOOLS AND SIMPLE MACHINES

I-112 Forming Sheet Metal On The Forming Rolls

I-116 Rotary Machine Rolls Identification

I-117 Wiring An Edge, Turning A Burr, Beading, And Crimping Using A Combination Rotary Machine

I-128 Chisels And Calipers Identification

I-132 Cutting With The Scroll Saw

I-150 Layout Tools Identification

I-152 Making A Simple Layout

I-153 Measuring The Thickness Of Sheet Metal And Wire Using Sheet Metal Gages

I-200 Commonly Used Hand Saws: Names And Uses

I-205 Verbal Identification: Power Hack Saw, Jig Saw, Band Saw, Table Saw, And Radical Arm Saw

I-211 Verbal Identification: C Clamp, Parallel Clamp, Machinist Vise, Woodworking Vise, Bar Clamp, Hand Screw Clamp And Mitre-Frame Clamp

I-212 Uses And/Or Applications Of Clamping And Holding Devices

I-214 Identification: Wire Stripper And Cutter

I-215 Verbal Identification: Hand Punch, Solid Punch, Bench Punch, Chassis Punch, And Hollow Punch

I-217 Verbal Identification: Auger Bit, Speed Bore Bit, Straight Shank Drill, Taper Shank Drill, Counter Bore Expansion Bit, And Compound Bit

I-220 Types Of Solder: Acid Core, Rosin Core And Lead-Tin

I-222 Removing A Rough Edge From Metal By Grinding And/Or Whetting

I-224 Criteria For The Selection Of Screwdrivers

I-225 Joining Materials Together With Mechanical Fasteners

I-230 Verbal Identification And Application: Electric Soldering Gun, Electric Soldering Copper [Iron], Soldering Copper, And Propane Torch With Soldering Tip

UNIT I - HAND TOOLS AND SIMPLE MACHINES

I-232 Soldering: Applying The Principle Of The Heat Sink

I-233 Joining: Soldering One Piece Of Metal To Another

I-235 Joining: Soldering Two Wires Together

I-238 Identification And Application: Side Cutting Pliers, Slip Joint Pliers, Lineman Pliers, And The Long Nose Pliers

I-240 Use Of Clamping And Holding Devices

UNIT J - Sophisticated Machines

J-1 Lathe Nomenclature

J-2 Lathe Safety Precautions

J-3 Basic Lathe Operation

J-4 Cutting A Taper

J-5 Knurling

J-6 Center Drilling

J-7 Twist Drilling On The Lathe

J-8 Shaper Nomenclature

J-9 Shaper Safety Test

J-10 Speeds And Feeds Used On The Shaper

J-11 Shaper Demonstration Outline

J-12 Student Lab Sheet For Shaper Operation

J-13 Milling Machine Nomenclature

J-14 Milling Machine Safety

J-15 Milling Machine Cutters

J-16 Feeds Used On A Milling Machines

J-17 Speeds Used On A Milling Machines

J-18 Climb Milling And Conventional Milling

UNIT J - SOPHISTICATED MACHINES

J-19 Suggested Guide For Milling Machine Demonstration

J-20 Differences Between Vertical And Horizontal Milling Machines

J-21 Student Lab Sheet For Basic Milling Machine Operation

J-110 Introduction To The Volt-Ohm-Milliammeter [Vom]

J-120 The Ohmmeter: Measuring Resistors

J-130 The Volt-Ohm-Milliammeter [Vom]
Used As A Directed Current [D.C.] Volymeter

J-200 Introduction To The Cathode Ray Oscilloscope

FOR THE STUDENT

No. A 1

INDUSTRY AND CIVILIZATION

FROM THE CAVE TO THE FACTORY

Objective:

You will list at least three factors which held man back in his evolution from the cave to the factory. You will also state three examples of the major factors in this evolution.

Activity:

You are going to play a four person game. The game will be fun and will also show you some facts about man's history from the time when he first developed as the cave man to the time when he first developed factories.

To participate in this activity follow these steps:

1. Group yourself in fours.
2. Elect a leader for your group.
3. The leader should obtain the game materials from the teacher.
4. The group leader then reads the game rules to the group. (see attached sheet)

Post test:

1. Write on a sheet of paper at least three factors (pitfalls) that held man back in his progress from the cave to the factory.

   A.
   B.
   C.

2. Write on a sheet of paper at least three factors (discoveries) that helped man along in his progress from the cave to the factory.

   A.
   B.
   C.

THE GAME RULES "FROM THE CAVE TO THE FACTORY" No. A-1

1. You should read all of the rules before you start the game.

2. The leader shuffles the safety cards and places them in the space provided.

3. The leader shuffles the suspense cards and places them in the space provided.

4. Each player should place his player piece at the starting point on the board.

5. Then each person should recognize that each space on the board represents a period of time, moving ahead on the board means moving ahead in time.

   Point out the following spaces:
   2,000,000 BC
   1,000,000 BC
   100,000 BC
   50,000 BC
   10,000 BC
   4,000 BC
   2,000 BC
   0
   1000 AD
   1500 AD

6. "Pitfall" space. There are pitfall spaces along the trail of the game. They are marked PF with a box around it. Point one out.

   If a player lands on a pitfall, he must first draw a safety card. If it states the word safety on the back side, then he can disregard the pitfall directions. If it is blank, then he must follow the pitfall directions.

7. "Discovery" space. There are discovery spaces along the trail of the game. They are marked D with a circle around it. Point one out.

   If a player lands on a discovery space, he will move his player ahead the indicated number of spaces.

8. At no time can more than one player be on a given space. If this occurs, regardless of reason, the players involved must throw the dice for the highest number. The player with the lowest number must go back that number of spaces. The player with the highest number will remain on the space.

9. "Suspense" space. There are suspense spaces along the trail of the game. They are marked S.S. Point one out.

   If a player lands on a suspense space, he must draw a suspense card from the stack and follow the directions given on the card.

10. IMPORTANT IMPORTANT IMPORTANT You must read each space as you move along the trail. If you move because of a discovery or a pitfall, the next player (if he rolls an even number on the dice) may challenge you to state the discovery or the pitfall. If you cannot state it, you will lose your next turn.

11. IMPORTANT If you move back spaces regardless of reason, do not follow the directions given on the space you have moved back to .... stay there until your next turn.

12. To complete the game the player must get the exact number on the dice as there are remaining spaces. If he doesn't, he must remain in place until his next turn.

13. The first person to reach goal THE FACTORY wins the game.

TO START THE GAME........

Each person takes the dice and throws for high number. The person that gets the highest number then begins the play by moving his player piece the number of spaces on the board that he received on the dice.

The play then goes around the board to the left of the first player.

BEGIN.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. A-1

Media:

For this package the student will need:

The game "From the Cave to the Factory"

The game will include the following:

1. The game board
2. The list of rules
3. The player pieces (4)
4. The dice
5. The safety cards (10)
6. The suspense cards (10)

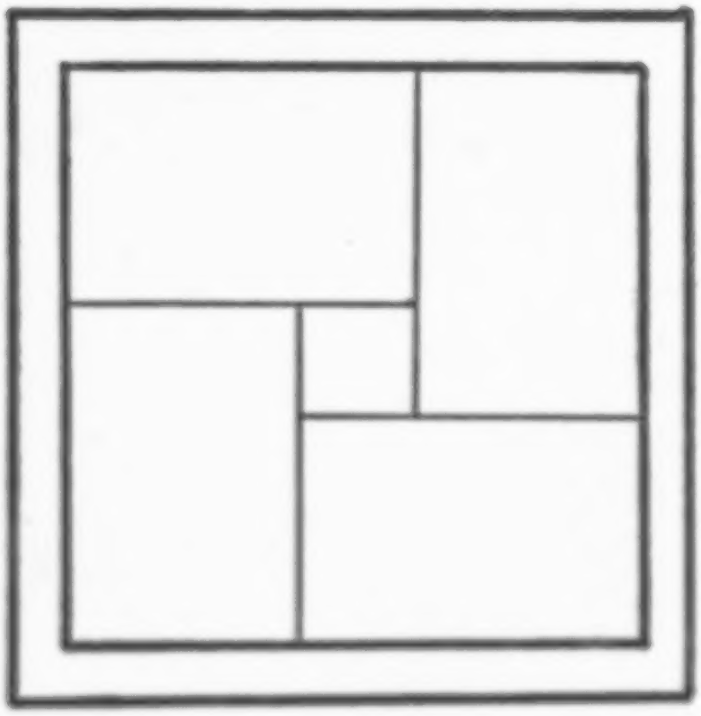
Making the game board, cards, and player pieces, etc.

A. To make the safety and suspense cards, use two pieces of 8½"x 11" paper and cut them into 10 equal pieces per sheet. (Each piece should be about 2 1/8"x 4 1/4".)

B. To make the player pieces simply use some nuts, bolts, screws, washers, or nails. HINT: Be sure to file or grind the points or heads of the pieces to prevent them from rolling.

C. You may notice that along the trails of the game there are blank spaces. These have purposely been left blank so that the teacher may enter some desirable concepts of his own.

D. To make the game board, position the four game sheets at right angles to each other, and place them on a piece of poster board. The poster board should be 21½" square. This will allow one inch on each side of the game sheets for the border. (See the diagram below)



GO AHEAD 1 SPACE

GO AHEAD 2 SPACES

GO BACK 1 SPACE

GO BACK 2 SPACES

MISS YOUR NEXT TURN

MISS YOUR NEXT TURN

IF YOU CAN GIVE THE DATE OF THE SPACE YOU ARE NOW ON, THEN MOVE AHEAD 2 SPACES

IF YOU CAN GIVE THE DATE OF THE SPACE YOU ARE NOW ON, THEN MOVE AHEAD 1 SPACE

YOU MUST EXCHANGE PLACES WITH THE PLAYER PIECE THAT IS DIRECTLY BEHIND YOUR PLAYER PIECE

YOU MUST EXCHANGE PLACES WITH THE PLAYER PIECE THAT IS DIRECTLY AHEAD OF YOUR PLAYER PIECE

SAFETY	
SAFETY	
SAFETY	
SAFETY	

S.S. 900 A.D.

D
RISE OF TOWNS
SURPLUS PRODUCTION OF FOOD AND
OTHER PRODUCTS MAKES THIS POSSIBLE
GO AHEAD 1 SPACE 800 A.D.

D
FAMILY PRODUCES SPECIAL ITEMS
IN SURPLUS FOR TRADE AND SALE
GO HEAD 1 SPACE 700 A.D.

FAMILY PRODUCES FOR OWN USE -
NO SURPLUSES
STAY WHERE YOU ARE 600 A.D.

PF
DARK AGE PERIOD
BURNING AND THE DECLINE
OF ROME AND ITS EMPIRE
GO BACK 3 SPACES 500 A.D.

S.S. 400 A.D.

D
GROWTH IN SHIP BUILDING
USED IN CONQUEST AND TRADE
GO AHEAD 1 SPACE 300 A.D.

EXPANSION OF ROMAN EMPIRE
SPREADS CULTURE TO OTHER PARTS
OF THE WORLD
DO NOT MOVE AHEAD
200 A.D.

PLOW IN COMMON USE
MORE FOOD SURPLUSES AVAILABLE
DO NOT MOVE AHEAD 100A.D

S.S. 0

D
ROMAN PERIOD
IRON USED COMMONLY, BETTER
TOOLS CAN PRODUCE
SURPLUS FOOD
GO AHEAD 1 SPACE
500 B.C.

D
IMPROVED AGRICULTURE
MORE GRAIN PRODUCED BECAUSE OF
BETTER TOOLS
GO AHEAD 1 SPACE 1,000 B.C.

D
IRON PRODUCED
MADE BETTER TOOLS AND WEAPONS
MORE FREE TIME
MOVE 0 SPACES 1,500 B.C.

PF
GREEK PERIOD
LARGE SCALE WARS
GO BACK 2 SPACES 2,000 B.C.

D
DOMESTICATION OF ANIMALS
CULTIVATION OF THE LAND
MORE FOOD MEANS MORE FREE TIME
GO AHEAD 1 2,500 B.C.

1,400,000 B.C.

1,500,000 B.C.

Ⓓ NATURAL WOOD CLUB IS DISCOVERED THIS MAKES IT POSSIBLE TO COLLECT MORE MEAT

MOVE AHEAD 1 SPACE 1,600,000 B.C.

1,700,000 B.C.

1,800,000 B.C.

Ⓓ SHARP STONE - MAKES IT POSSIBLE TO HUNT MORE SUCCESSFULLY

MOVE AHEAD 2 SPACES 1,900,000 B.C.

HUNTING AND FOOD GATHERING FOR SURVIVAL

DO NOT MOVE AHEAD 2,000,000 B.C.

SAFETY

START

OLD STONE AGE OR PALEOLITHIC AGE TOOLS MADE OF STONE

THIS PERIOD IS ABOUT FROM 3,000,000 B.C. TO 2,000,000 B.C.

GOAL

THE FIRST SIGNS OF REAL FACTORY PRODUCTION SYSTEMS

1,500 A.D.

Ⓓ PLACEMENT OF MANY WORKERS UNDER ONE ROOF FOR MANUFACTURING PURPOSES

GO AHEAD 1 SPACE

1,400 A.D.

WHOLESALE CRAFT SYSTEM PRODUCTS SOLD BY PERSONS OTHER THAN THE CRAFTSMAN

DO NOT MOVE 1,300 A.D.

PURCHASE OF RAW MATERIALS FROM SEPARATE SUPPLIER OTHER THAN SELF

STAY WHERE YOU ARE 1,200 A.D.

Ⓓ CRUSADES STARTED CRAFT GUILDS FORMED PRODUCT QUALITY CONTROLLED

GO AHEAD 1 SPACE 1,100 A.D.

PF MIDDLE AGE PERIOD MERCHANT GUILDS STARTED CONTROL OF PRODUCT PRICES

GO BACK 1 SPACE 1,000 A.D.

S.S.

80,000 B.C.

D YOU FIND THAT YOU CAN MAKE CLOTHING OUT OF ANIMAL SKINS

GO AHEAD 1 SPACE 90,000 B.C.

D MIDDLE PALEOLITHIC AGE
CAVES - FOUND CAVES FOR DWELLINGS WITH PROTECTION FROM NATURE

MOVE AHEAD 1 SPACE 100,000 B.C.

PF SEVERE WEATHER CONDITIONS
YOU CAN NOT GATHER ENOUGH FOOD FOR SURVIVAL

200,000 B.C.

300,000 B.C.

PF ILLNESS KILLS MANY OF YOUR GROUP
YOU HAVE NO PROTECTION

400,000 B.C.

D MAN FASTENS STONE TO CLUB
CAN NOW HUNT WITH GREATER SUCCESS
THIS MEANS MORE FOOD AND FREE TIME

600,000 B.C.

S.S. 700,000 B.C.

800,000 B.C.

PF A LARGER WANDERING TRIBE JUST CHASED YOU AWAY FROM YOUR FOOD SOURCE - NOW YOU MUST MOVE

900,000 B.C.

1,000,000 B.C.

1,100,000 B.C.

D NEW FOOD SOURCE - YOU DON'T HAVE TO SPEND ALL YOUR TIME HUNTING
YOU NOW CAN WORK ON TOOLS

GO AHEAD 2 SPACES 1,200,000 B.C.

PF WILD ANIMALS JUST STOLE YOUR FOOD SUPPLY

GO BACK 2 SPACES 1,300,000 B.C.

3,000 B.C.

D

BRONZE AGE - WRITING DEVELOPED
YOU FIND METAL MAKES BETTER TOOLS
AND WEAPONS

GO AHEAD 1 SPACE 3,500 B.C.

D

NEOLITHIC AGE - EGYPTION PERIOD
THE CRUDE PLOW IS DEVELOPED, NOW
YOU CAN GROW MORE FOOD NEAR TRIBE

GO AHEAD 2 SPACES 4,000 B.C.

5,000 B.C.

SUSPENSE

D

YOU FIND THAT YOU CAN HERD ANIMALS
FOR FOOD RESERVE AND THIS MEANS MORE
FREE TIME TO WORK ON TOOLS

GO AHEAD 1 SPACE 6,000 B.C.

PF

YOU JUST HAD A WAR WITH ANOTHER TRIBE
FOR THE FOOD SUPPLY AREA
SORRY, BUT YOU LOST
GO BACK 1 SPACE 7,000 B.C.

8,000 B.C.

D

DEVELOPMENT OF LARGE TRIBES
BETTER TOOLS, MORE FOOD TO
FEED - MORE PEOPLE

GO AHEAD 1 SPACE

9,000 B.C.

D

MESOLITHIC AGE
POLISHING STONES INTO NEEDED
SHAPES FOR BETTER TOOLS
MEANS MORE FOOD

GO AHEAD 2 SPACES
10,000 B.C.

PF

THE REINDEER HERD MOVES NORTH
YOU MUST FOLLOW IT FOR FOOD
YOU CAN'T CARRY ALL YOUR TOOLS

GO BACK 2 SPACES
20,000 B.C.

S.S. 30,000 B.C.

40,000 B.C.

D

UPPER PALEOLITHIC AGE
FLINT TOOLS ARE USED TO MAKE HUNTING
AND FOOD GATHERING EASIER

GO AHEAD 2 SPACES 50,000 B.C.

PF

FIRES ARE PUT OUT BY SEVERE STORMS

GO BACK 3 SPACES 60,000 B.C.

D

THE USE OF FIRE IS DISCOVERED

GO AHEAD 2 SPACES 70,000 B.C.

FOR THE STUDENT No. A 2

INDUSTRY AND CIVILIZATION

THE INDUSTRIAL REVOLUTION

Objective:

You will be able to list several of the major developments and inventions of the industrial revolution. In addition you will be able to discuss the need for and the results of these inventions. In the discussions you will also be able to indicate for many of the inventions the approximate date (within a 1/2 century) and the name of the inventor.

Activity:

You are going to play a card game. It can be played with 4 persons. The game will be fun and will also show you some facts and ideas about the industrial revolution.

To participate in this activity follow these steps:

1. Collect a group of 4 persons.
2. Elect a leader for your group.
3. The leader should obtain the game materials from the teacher.
4. The group leader then reads the introduction and the game rules to the group. (see attached sheet)

Post test:

Written:
Write on a sheet of paper at least 10 developments or inventions that were important to man and occurred during the industrial revolution. Try to list them in the proper time order. If you can list more than 10, do so.

Oral:
Engage in a general class discussion. Some important discussion points are:

1. Important inventions.
2. Inventors names.
3. The need for the invention.
4. The results of the invention.
5. Approximate date of the invention.

INTRODUCTION - THE INDUSTRIAL REVOLUTION

The Industrial Revolution covers the approximate time of the early 1700s through the late 1800s. Many different authorities will suggest many different time spans, but all will fall within this given time. Because it is felt that the Industrial Revolution is a continuing thing, this game will continue on into the middle of the 1900s.

The Industrial Revolution is a period of time in man's history when many important developments and inventions were made. During this time man made great strides in his industrial growth. Many of the inventions created the need for even more inventions. Thus the Industrial Revolution was like a snowball rolling down hill and as it rolled it grew in size and continued to gain speed. The textile industry (cloth and clothing) is where the first great developments occurred. This was followed by developments in many other important areas which led to the giant industrial complexes we now have. In most cases the invention was the result of man wanting to be able to make something better and faster than he could by hand.

THE CARD GAME RULES AND INSTRUCTIONS

Sorting the cards:

There are 108 individual cards. To make the game more easily handled it would be best to divide the cards into two separate games. To do this, sort out all the cards with the date of 1850 and below. These 57 cards will be used for one game. The other 51 cards (those above 1850) will be used for a second game.

Description of the cards:

The cards all represent some development or invention of the Industrial Revolution. There are 3 cards for each invention (3 cards per suit).

Each card has on it:

1. The date of the invention.
2. The name of the invention.
3. A picture of the invention. (the suit symbol, example, apicture of a light bulb would be like the spade or club on a regular card.)

At the bottom is where the cards differ. One card has the name of the person or persons who were most involved in the invention or development. Another card has a statement suggesting the major need for the invention and the last card has at the bottom the result of the invention. The result statement will give only the major result of the invention, showing how it advanced man's industrial development.

Rules:

1. The game should be played with 4 persons.

2. The elected leader deals first. The winner will deal the next hand.

3. The cards should be shuffled and dealt to the left.

4. Each player is dealt 5 cards face down. The rest of the cards are placed face down in a stock pile in the center. The dealer turns up one card from the stock pile and places it beside the pile.

5. Players examine their cards and the dealer begins play.

6. Each player, at his turn, must draw from the stock pile and discard a card face up.

7. Draw can be made from the discard pile instead of the stock pile. If you do, you must take all the cards down to the one you need. You must make a play with the bottom card of the pile you have taken.

8. To score points:
   All cards laid down for points must be read aloud to the group. If the hand is taken away before this is done, any other player who is first to yell "Industrial Revolution" receives the cards and the points.

9. If a player has all 3 cards of a suit (invention), at his turn for play he should lay them face up on the table. Remember to read each card to the group before you take your hand away!
   The player receives 25 points for this.

10. A player can lay down 2 cards of a suit for 10 points.

11. If another player has the third card of a suit which has been played, he may lay it down at his turn for 5 points.

12. If a player who has played the first 2 cards of a suit, draws the third card, he lays it down separately for 5 points. (he doesn't count this as a suit of 3 for 25 points.)

13. All play ends when one player has no cards left in his hand.

14. If the stock pile runs out, play continues around the table until no further play is possible.

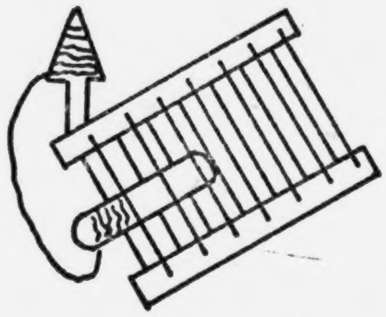
15. Each card left in your hand at the end of play subtracts 5 points from your total score.

16. At the end of play each player adds up his score. Highest score wins.
    A running score can be kept by playing the game several times and adding the scores together.

BEGIN AND HAVE FUN

1733

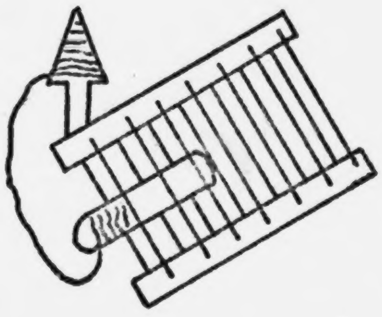
FLYING SHUTTLE



NEED
FASTER WAY TO WEAVE
CLOTH

1733

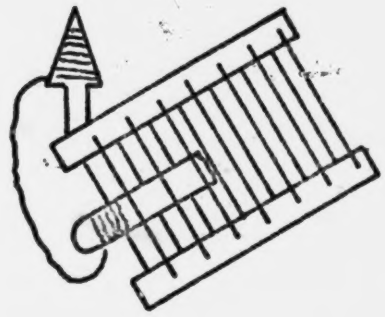
FLYING SHUTTLE



JOHN KAY

1733

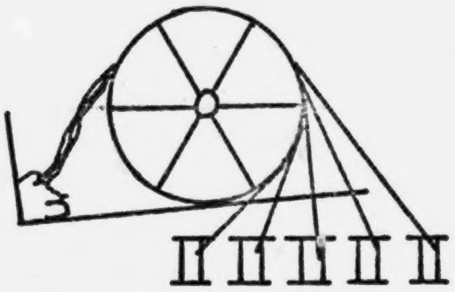
FLYING SHUTTLE



RESULT
CLOTH COULD BE MADE
MUCH FASTER

1764

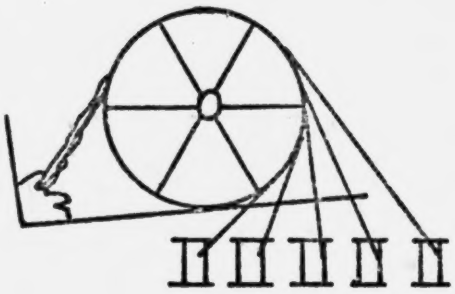
SPINNING JENNY



NEED
FASTER WAY TO SPIN
YARN

1764

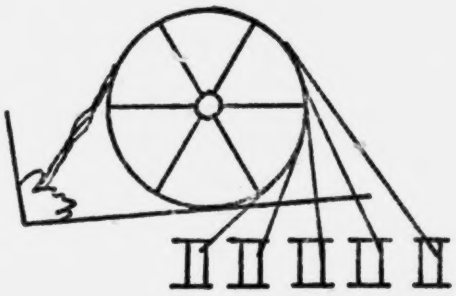
SPINNING JENNY



JAMES HARGREAVES

1764

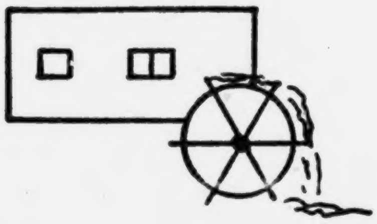
SPINNING JENNY



RESULT
SPINNERS CAN KEEP UP
WITH THE DEMAND

1771

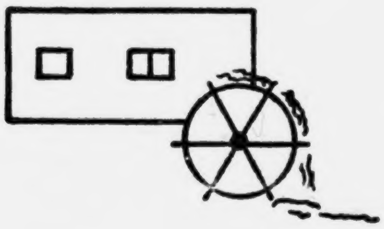
WATER FRAME &
TEXTILE FACTORIES



NEED
A BETTER WAY TO MAKE
CLOTH

1771

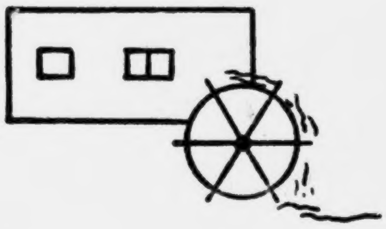
WATER FRAME &
TEXTILE FACTORIES



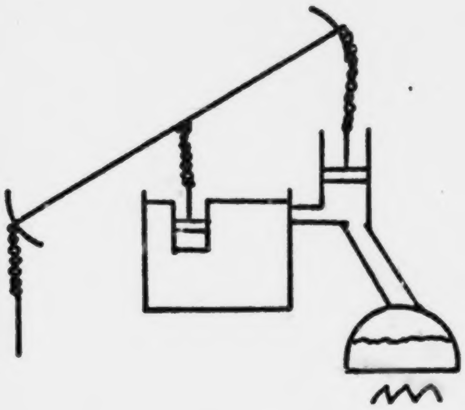
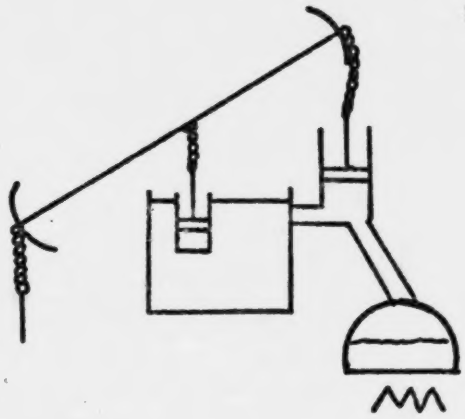
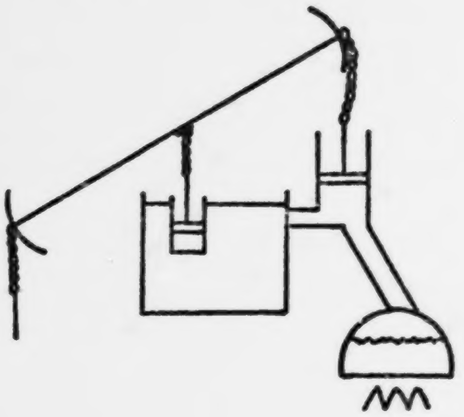
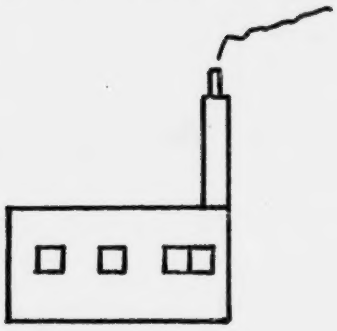
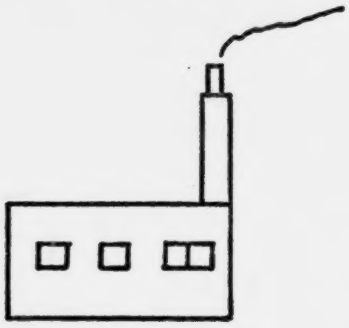
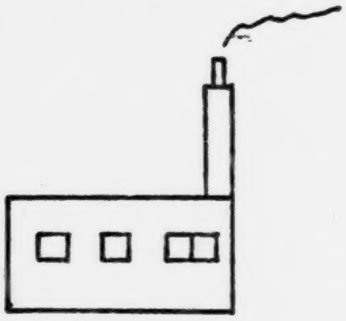
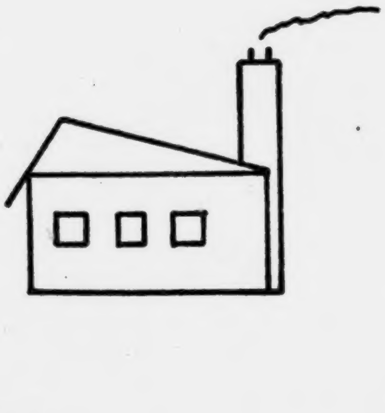
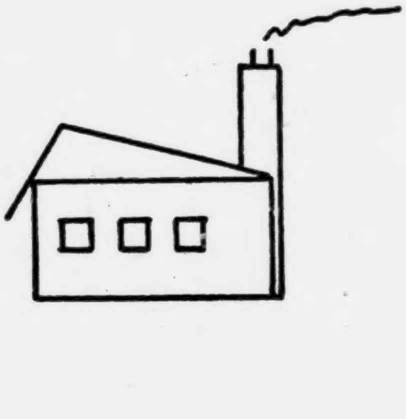
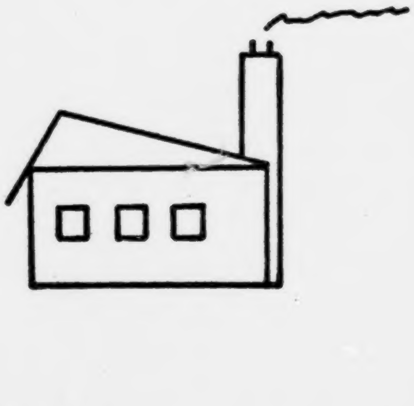
RICHARD ARKWRIGHT

1771

WATER FRAME &
TEXTILE FACTORIES

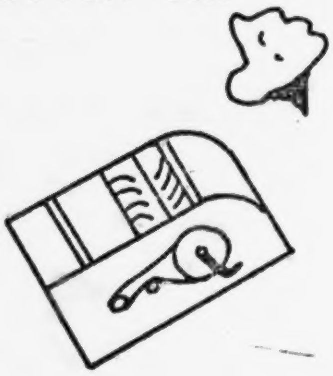


RESULT
FACTORY GROWTH CLOTH
PRODUCED CHEAPER

1763 - 1769 STEAM ENGINE  NEED A BETTER POWER SOURCE	1763 - 1769 STEAM ENGINE  THOMAS SAVERY THOMAS NEWCOMEN JAMES WATT	1763 - 1769 STEAM ENGINE  RESULT POWER TO DRIVE MACHINES
1785 POWER LOOM  NEED BETTER WAY TO MAKE CLOTH	1785 POWER LOOM  EDMUND CARTWRIGHT	1785 POWER LOOM  RESULT MORE CLOTH & MORE JOBS
1790 SPINNING MILLS U.S.  NEED INDUSTRY & TEXTILES	1790 SPINNING MILLS U.S.  SAMUEL SLATER	1790 SPINNING MILLS U.S.  RESULT FATHER OF THE U.S. FACTORY SYSTEM

1793

COTTON GIN



NEED
A MECHANICAL WAY
TO CLEAN COTTON

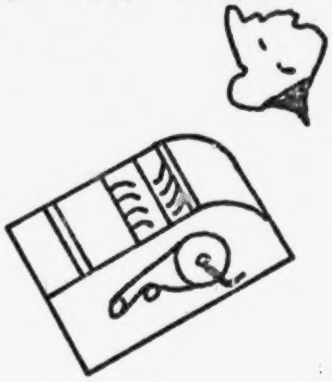
1793

COTTON GIN

ELI WHITNEY

1793

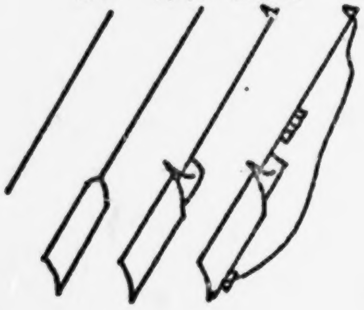
COTTON GIN



RESULT
SAVED THE ECONOMY
OF THE SOUTH

1800

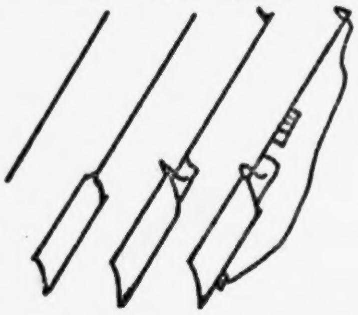
MASS PRODUCTION
OF RIFLES



NEED
A WAY TO PRODUCE
BY MACHINES

1800

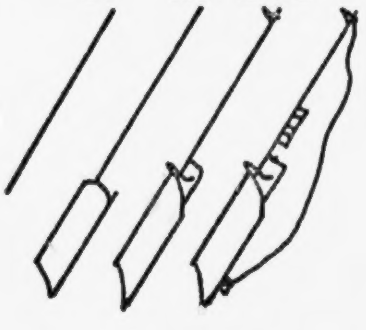
MASS PRODUCTION
OF RIFLES



ELI WHITNEY

1800

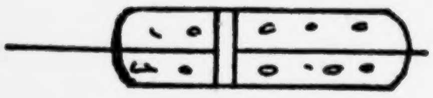
MASS PRODUCTION
OF RIFLES



RESULT
FIRST MASS PRODUCTION
IN A MECHANIZED WAY

1787

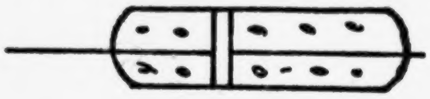
DOUBLE ACTING
STEAM ENGINE



NEED
A POWER SOURCE FOR
DRIVING MACHINES

1787

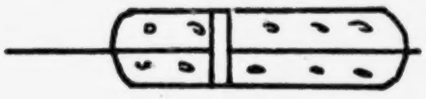
DOUBLE ACTING
STEAM ENGINE



OLIVER EVANS

1787

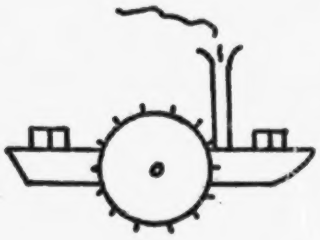
DOUBLE ACTING
STEAM ENGINE



RESULT
POWER ENOUGH TO
REPLACE HORSES &

1807

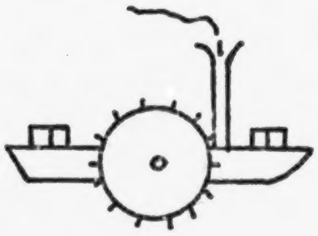
STEAMBOAT



NEED
BETTER
TRANSPORTATION

1807

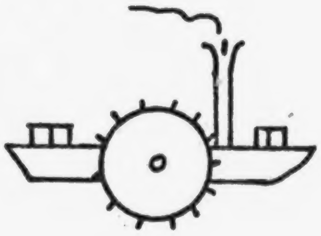
STEAMBOAT



ROBERT FULTON

1807

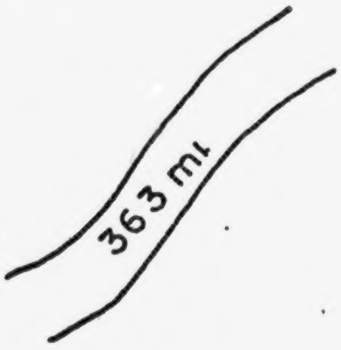
STEAMBOAT



RESULT
ECONOMY CAN GROW

1817-1825

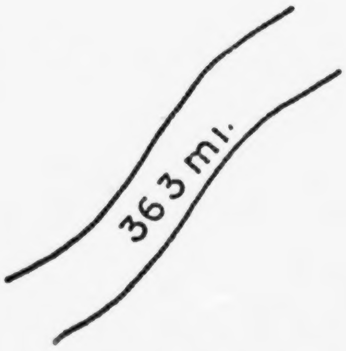
ERIE CANAL



NEED
BETTER
TRANSPORTATION

1817-1825

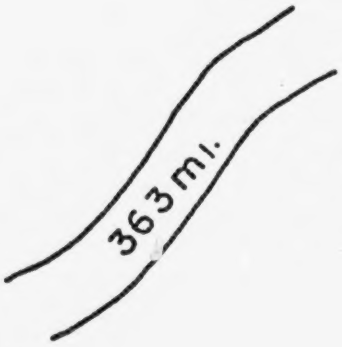
ERIE CANAL



GOV. NEW YORK
DEWITT CLINTON

1817-1825

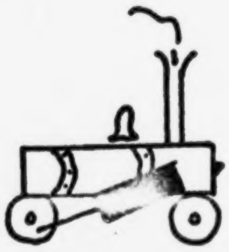
ERIE CANAL



RESULT
HELPED SETTLE THE
GREAT LAKES AREA

1825

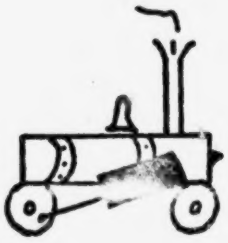
FIRST LOCOMOTIVE
TO RUNIN U.S.



NEED
BETTER
TRANSPORTATION

1825

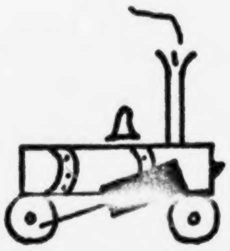
FIRST LOCOMOTIVE
TO RUN IN U.S.



COLONEL
JOHN STEVENS

1825

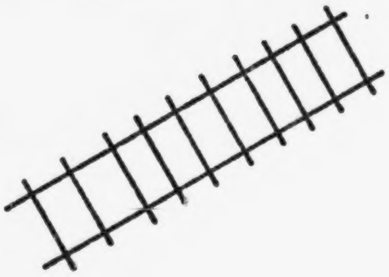
FIRST LOCOMOTIVE
TO RUN IN U.S.



RESULT
GROWTH IN
INDUSTRY

1830

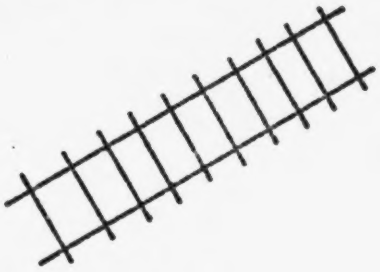
RAILROAD



NEED
A WAY TO GET INTO
THE WILDERNESS

1830

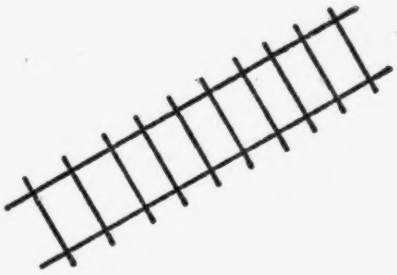
RAILROAD



S. CAROLINA CANAL &
RAILROAD CO.

1830

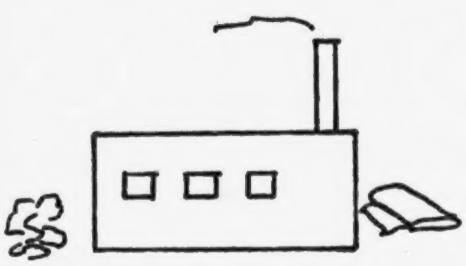
RAILROAD



RESULT
OPENED THE
WILDERNESS

1813

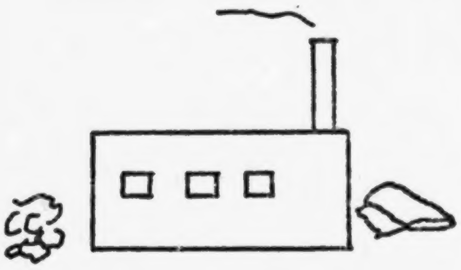
COMPLETE US
TEXTILE FACTORY



NEED
INDUSTRIAL
MECHANIZATION

1813

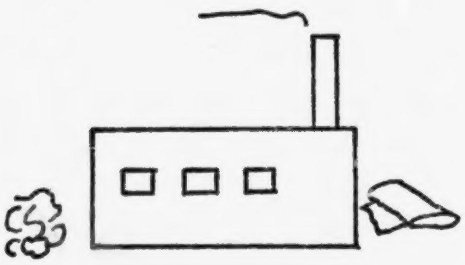
COMPLETE US
TEXTILE FACTORY



FRANCIS LOWELL
PAUL MOODY

1813

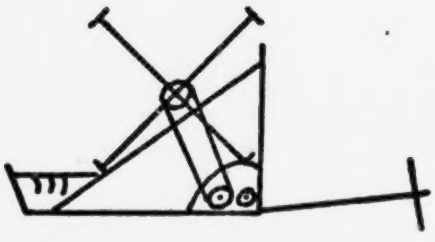
COMPLETE US
TEXTILE FACTORY



RESULT
LOWELL MASS.-CENTER
OF TEXTILE PRODUCTION

1834

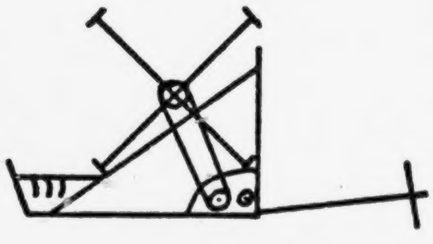
MECHANICAL
REAPER



NEED
MECHANICAL GRAIN
HARVESTER

1834

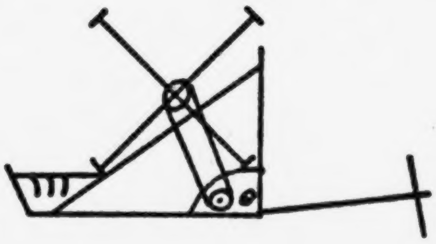
MECHANICAL
REAPER



OBED HUSSEY
ROBERT & CYRUS
McCORMICK

1834

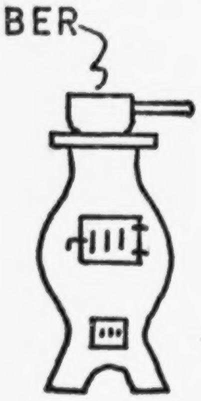
MECHANICAL
REAPER



RESULT
CAN GROW LARGER
CROPS

1844

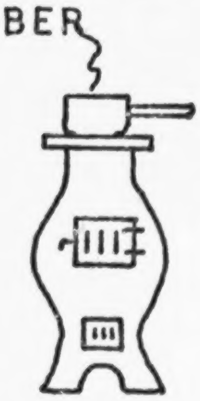
VULCANIZED RUBBER



NEED
CURED RUBBER
PRODUCTS

1844

VULCANIZED RUBBER



CHARLES
GOODYEAR

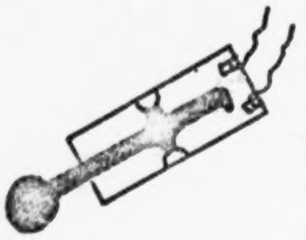
1844

VULCANIZED RUBBER

RESULT
LARGE RUBBER
INDUSTRIES

1835

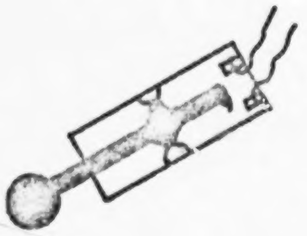
TELEGRAPH



NEED
BETTER
COMMUNICATIONS

1835

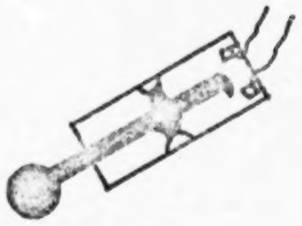
TELEGRAPH



SAMUEL MORSE

1835

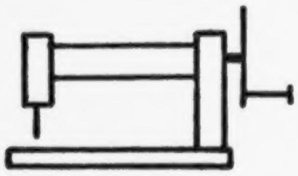
TELEGRAPH



RESULT
MORE INDUSTRIAL
GROWTH

1830

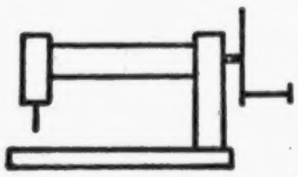
SEWING MACHINE



NEED
FASTER WAY TO
MAKE CLOTHING

1830

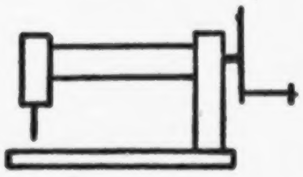
SEWING MACHINE



THIMONIER
BARTHOLOMEY

1830

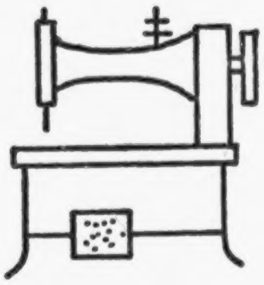
SEWING MACHINE



RESULT
GROWTH IN THE
CLOTHING INDUSTRY

1851

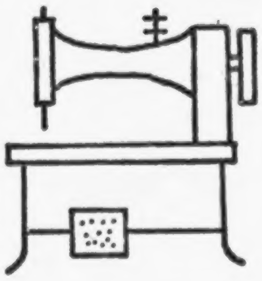
PERFECTED SEWING MACHINE



NEED
MECHANICAL WAY TO SEW CLOTHES

1851

PERFECTED SEWING MACHINE



ISAAC SINGER
ELIAS HOWE

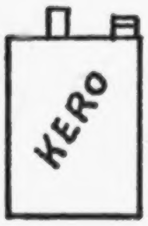
1851

PERFECTED SEWING MACHINE

RESULT
REVOLUTIONIZED THE CLOTHING INDUSTRY

1846

KEROSENE FROM COAL



NEED
FUEL FOR LAMPS

1846

KEROSENE FROM COAL

DR. ABRAHAM GESNER

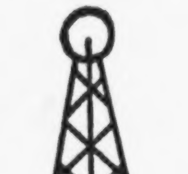
1846

KEROSENE FROM COAL

RESULT
LARGE DISTILLING & MINING INDUSTRIES

1859

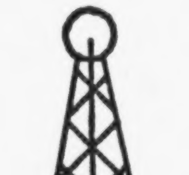
FIRST OIL WELL



NEED
BETTER FUEL

1859

FIRST OIL WELL

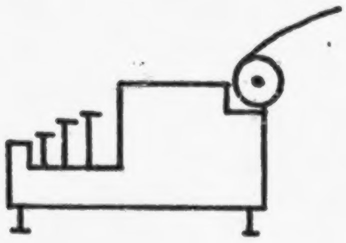
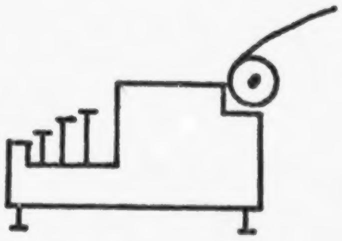
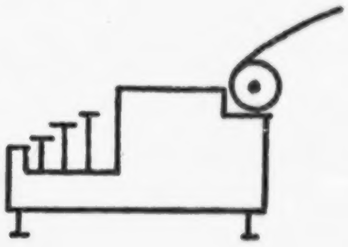
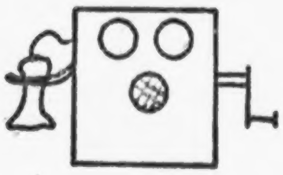
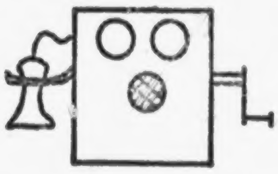
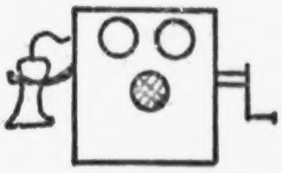
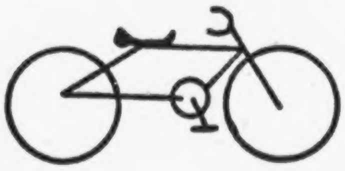
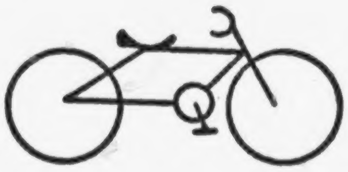
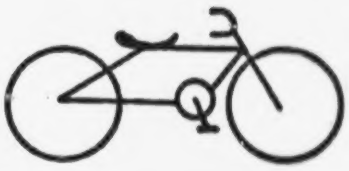


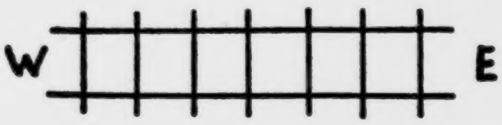
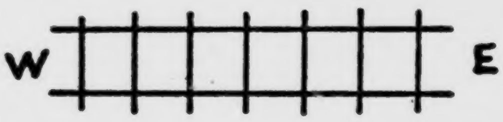
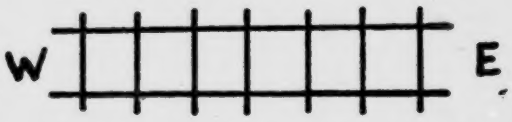
EDWIN DRAKE

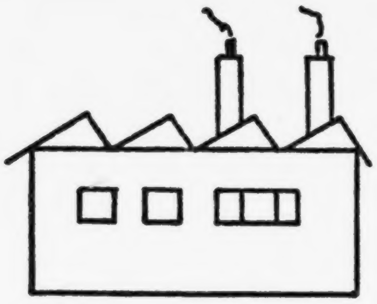
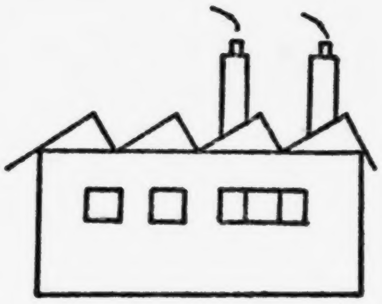
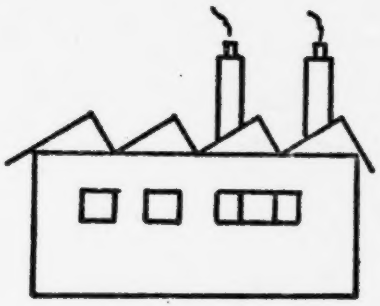
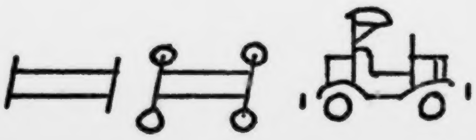
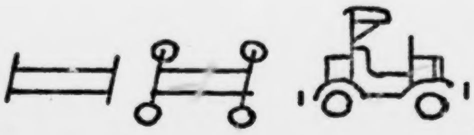
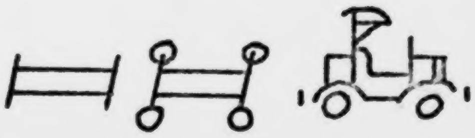
1859

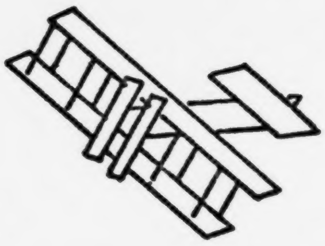
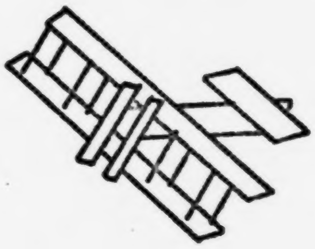
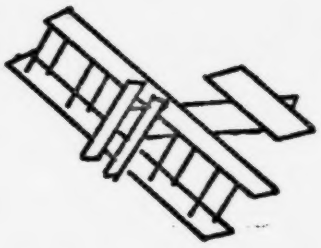
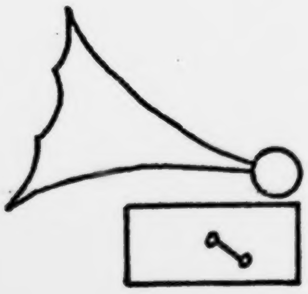
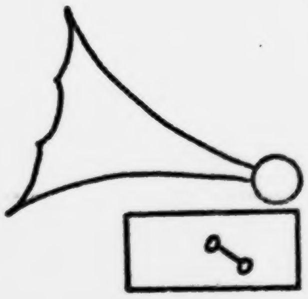
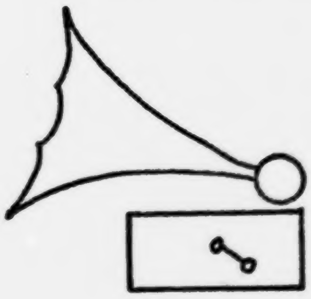
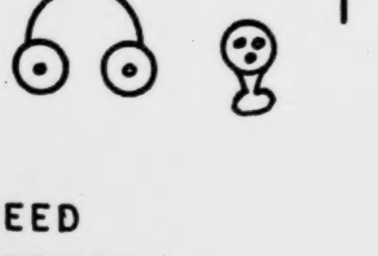
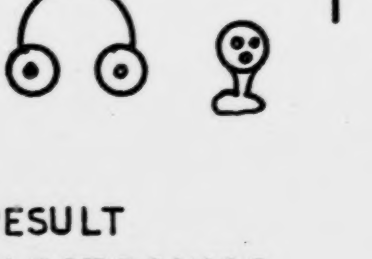
FIRST OIL WELL

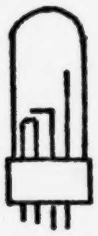
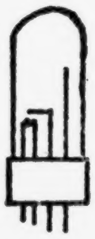
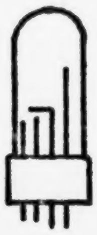
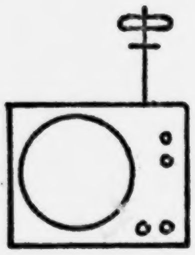
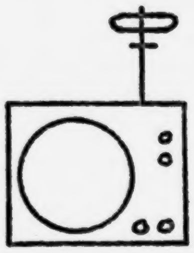
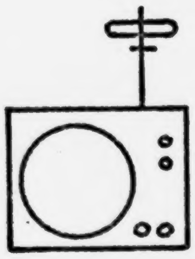
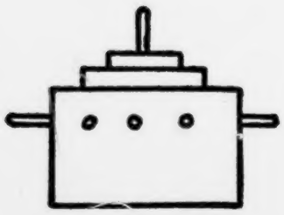
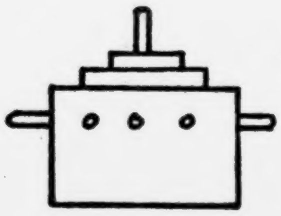
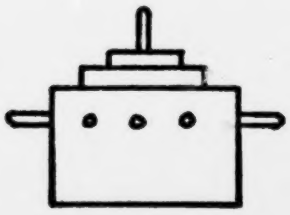
RESULT
OIL INDUSTRY STARTED

1867 TYPEWRITER  NEED BETTER WRITING SYSTEM	1867 TYPEWRITER  CHRISTOPHER SHOLES	1867 TYPEWRITER  RESULT A NEW INDUSTRY MORE JOBS
1876 TELEPHONE  NEED BETTER COMMUNICATIONS	1876 TELEPHONE  ALEXANDER GRAHAM BELL	1876 TELEPHONE  RESULT A NEW INDUSTRY MORE JOBS
1877 FIRST US BICYCLE FACTORY  NEED TRANSPORTATION	1877 FIRST US BICYCLE FACTORY  ALBERT POPE	1877 FIRST US BICYCLE FACTORY  RESULT MORE JOBS NEED ROADS

1879 ELECTRIC LIGHT NEED A CLEAN LIGHTING SYSTEM	1879 ELECTRIC LIGHT THOMAS EDISON	1879 ELECTRIC LIGHT RESULT BEGINNING OF A NEW INDUSTRY
1854 BESSEMER PROCESS NEED BETTER WAY TO MAKE STEEL	1854 BESSEMER PROCESS HENRY BESSEMER ROBERT MUSHET	1854 BESSEMER PROCESS RESULT GROWTH IN STEEL INDUSTRIES
1869 E TO W RAILROAD  NEED BETTER & FASTER TRANSPORTATION	1869 E TO W RAILROAD  CENTRAL & UNION PACIFIC RAILROADS	1869 E TO W RAILROAD  RESULT CONNECTED EAST & WEST

1892 FIRST US MOTOR WAGON CO.  NEED MORE INDUSTRY & TRANSPORTATION	1892 FIRST US MOTOR WAGON CO.  CHARLES & FRANK DURYEA	1892 FIRST US MOTOR WAGON CO.  RESULT BEGINNINGS OF THE AUTO INDUSTRY
1890 FIRST AUTOMOBILE ASSEMBLY LINE  NEED MECHANIZATION OF AUTO INDUSTRY	1890 FIRST AUTOMOBILE ASSEMBLY LINE  RUSSELL E OLDS	1890 FIRST AUTOMOBILE ASSEMBLY LINE  RESULT BEGINNING OF MASS PRODUCTION
1907 MODEL T FORD NEED INEXPENSIVE AUTO	1907 MODEL T FORD HENRY FORD	1907 MODEL T FORD RESULT GREAT GROWTH IN AUTO PRODUCTION

1903 AIRPLANE  NEED TO FLY	1903 AIRPLANE  WILBUR & ORVILLE WRIGHT	1903 AIRPLANE  RESULT NEW INDUSTRY MORE JOBS
1878 PHONOGRAPH  NEED A METHOD OF RECORDING SOUND	1878 PHONOGRAPH  THOMAS EDISON	1878 PHONOGRAPH  RESULT MORE INDUSTRY MORE JOBS
1895 WIRELESS  NEED BETTER COMMUNICATIONS	1895 WIRELESS GUGLIELMO MARCONI	1895 WIRELESS  RESULT ELECTRONICS INDUSTRY

1903 TRIODE VACUUM TUBE  NEED BETTER COMMUNICATIONS	1903 TRIODE VACUUM TUBE  LEE DEFOREST	1903 TRIODE VACUUM TUBE  RESULT COMMUNICATIONS ADVANCED
1923 TELEVISION  NEED NEW PRODUCTS	1923 TELEVISION  DR. VLADIMIE ZWORYKIN	1923 TELEVISION  RESULT INDUSTRIAL GROWTH IN ELECTRONICS
1942 ATOMIC PILE  NEED NEW ENERGY SOURCE	1942 ATOMIC PILE  DR. ENRICO FERMI	1942 ATOMIC PILE  RESULT ATOMIC ENERGY

FOR THE STUDENT

No. A 3

INDUSTRY AND CIVILIZATION

AMERICAN ENTERPRISE GAME

(AUTOMATION, MANAGEMENT AND LABOR UNIONS)

Objective:

You will list at least three factors that the labor unions did, that were instrumental in meeting the needs of the worker. You will also state three examples of what automation did to, or for, the worker.

Activity:

You are going to play a game that will be played by two or more persons. The game will show you some facts about man in our technological society. The game will deal with labor unions and their functions, automation and its effects, and management problems.

To participate in this activity follow these steps:

1. Choose your group leader for the game.
2. Elect a leader for your group.
3. The leader should obtain the game materials from the teacher.
4. The group leader then reads the game rules to the group. (see attached sheet)

Post test:

1. Write on a sheet of paper at least three factors that the labor unions did, that were instrumental in meeting the needs of the worker.

   A.
   B.
   C.

2. Write on a sheet of paper at least three examples of what automation did to, or for, the worker.

   A.
   B.
   C.

THE GAME RULES OF "AMERICAN ENTERPRISE" No. A-3

1. You should read all of the rules before you start the game.

2. The leader shuffles the 4 sets of cards and places them in the space provided.

3. The leader distributes $1,000,000 in negotiable bonds to each player divided as follows:

   5 - $100
   3 - $500
   3 - $1,000
   3 - $5,000
   3 - $10,000
   3 - $50,000
   3 - $100,000
   1 - $500,000

4. The leader shall take care of all the industry cards (stocks), and distribute them to each player during the game, when the payment is made.

5. The leader will take care of all transactions dealing with finance, all payments, and transfer of stock.

6. Each player should place his player piece on the starting space.

7. Negotiable bonds will be used as a basis for all payments of goods, fees, fines and services.

8. On the board you will notice 4 major areas of industries. Under each major area you will find individual industries. (The leader should point these 4 major areas of industries out to the other players.)

9. A player must purchase any individual industry when he lands on it with his player piece. If the industry has been previously purchased by another player, then the player that landed on that particular space must pay the designated amount of negotiable bonds to the owner. If for any reason a player does not have the needed amount of negotiable bonds to purchase an industry, he then retires from the game, and all his holdings and negotiable bonds must be turned over to finance. He then assumes the responsibility of all financial transactions.

10. To purchase any industry a player must pay the designated amount of negotiable bonds for controlling stock in that industry.

11. A player may increase the profits of his industries by purchasing from the leader, additional units for increased production. These units may be bought only if the player has 2 or more industries under one major area.
These additional units are:

    1. Automated equipment - bolt
    2. Computer systems - nut
    3. Research and development - washer

    These units may only be added one at a time and only if the player lands on and owns that industry. A player may not add additional units to his industry at the time of purchase.

12. Any time a player has added additional units. such as automated equipment, computer systems, or research and development to his industry, the cost of his product will increase.

13. Any time a player lands on a corner space, he must draw the appropiate card for that space and follow its directions.

14. If a player lands on any corner space, he must repeat aloud, to the other players, the directions or information contained on that card, and then follow its directions.

15. If a player lands on a "strike" space, he must go directly to the labor union space, draw a card and follow the directions. He must not pass start.

16. A player stops at the start space on the board each time around. He must stop even if he receives a larger number on the dice. However, if doubles were thrown to reach start the player may roll the dice again, after he draws a finance card.

17. If doubles are thrown the player throws again and moves his player piece as before. If however, a player throws doubles 2 times in succession, he forfeits his next turn.

18. Negotiable bonds may not be loaned to any player by finance, nor may any player borrow from, or lend bonds to another player.

19. There are two methods for ending the game:

    1. The game ends after two players have forfeited their stocks and bonds, to finance or other players. The player with the most assets at this time wins the game.

2. Time limit:

   The player with the most assets at the end of the period, or specified time wins the game.

20. To determine total assets for ending the game, a player will sell back to finance, at the purchase price, his entire holdings.

21. For a longer game:

    A. You may include a bankruptcy clause that will give a player a chance to receive negotiable bonds, at purchase price, for his stock in the industry. The industry will then go back to finance.

    B. And, or: The players may elect to increase the $1,000,000 negotiable bonds used in the game. This can be done simply by passing out, at the beginning of the game, more negotiable bonds.

22. A list of definitions has been added to aid the student in understanding the many complex, but familiar words used in our technological society.

TO START THE GAME..........

Each person takes the dice and throws for high number. The person that gets the highest number then begins the play by moving his player piece the number of spaces on the board that he received on the dice.

The play then goes around the board to the left of the first player.

BEGIN.

THE LIST OF DEFINITIONS

1. Anti trust Law - is a law that is opposed to or regulating trust such as in business, for prevention of large organizational control of a product.

2. Bankruptcy - anything or anyone legally declared unable to pay his debts.

3. Collateral - designating or of security, given as a pledge for the repayment of a loan.

4. Contract - a mutual agreement, usually written between two or more persons which binds the parties to a performance.

5. Inflation - an increase in the currency in circulation or a marked expansion of credit, resulting in a fall in currency value and a sharp rise in prices.

6. Monopoly - an exclusive control of a commodity, or service in a given market.

7. Negotiable bonds - is an interest bearing certificate issued by a government, or a business that may be transfered from one person to another.

8. New Deal Legislation - is a term that was adopted by President Franklin D. Roosevelt dealing with his principles and policies to advance the economic and social welfare of the American people in the 1930's.

9. Power of attorney - authority given to a person to act for another, mainly for legal purposes in business transactions.

10. Proxy - the authority to act for another, as in voting. In the case of business a proxy may be used as a stockholder to determine the controllers of the company.

11. Stocks - shares of corporate capitol, or the certificate showing such ownership.

12. Substantial - large, or ample and important, generally in reg ards to monetary (money) value.

13. Technical - dealing with industrial and mechanical arts.

14. Technological - the systematic treatment of the practical or industrial arts as it is applied.

15. Workmans compensation - pay given to make up for lost work time if sickness or accident occurs on the job.

TEACHER'S REFERENCE FOR STUDENT PACKAGE NO. A-3

Media:

For this package the student will need:

The game "American Enterprise"

The game will include the following:

1. The game board
2. The list of rules
3. The player pieces (4)
4. One pair of dice
5. A list of definitions
6. The management cards(12)
7. The automation cards(12)
8. The labor union cards(12)
9. The financial cards(12)
10. The industry (stocks) cards(21)
11. The 21 bolts (automated equipment)- The bolts and nuts must have the same thread size.
12. The 21 nuts (computer systems)
13. The 21 washers (research and development)
14. The negotiable bonds in the following denominations:

36 - $100
24 - $500
24 - $1,000
24 - $5,000
24 - $10,000
24 - $50,000
24 - $100,000
24 - $500,000

Making the game board, cards and player pieces, etc.

A. To make the player pieces simply use some nuts, bolts, screws, washers, or nails. HINT: Be sure to file or grind the points, or heads, of the pieces to prevent them from rolling.

B. To make the industry(stocks) cards and the negotiable bonds, use 81/2" x 11" paper. You will have 12 on each page, and will need 19 pages. (Each negotiable bond and industry stock card should be 2" x 3 1/2" this will leave about 1/4" border on each page.)

C. To make the management, financial, labor union and automation cards, use 8 1/2" x 11" paper. You will have 6 on each page and you will need 8 pages. (Each management, financial, labor union and automation card should be 3 1/2" x 3 1/2" square, this will leave about 1/4" margin on each end and about 3/4" on each side of the paper.)

D. You may notice there has been some mention of cards throughout the game. This simply means that you should place poster board on the management, financial, labor union, automation and industry stock cards, to give them a rigid back. The negotiable bonds do not need a backing, as they will be used as currency.

E. In case you prefer not to use dice you may use a spinner with appropriate numbers. This may alleviate any problems, that may arise in school, because of the dice problem.

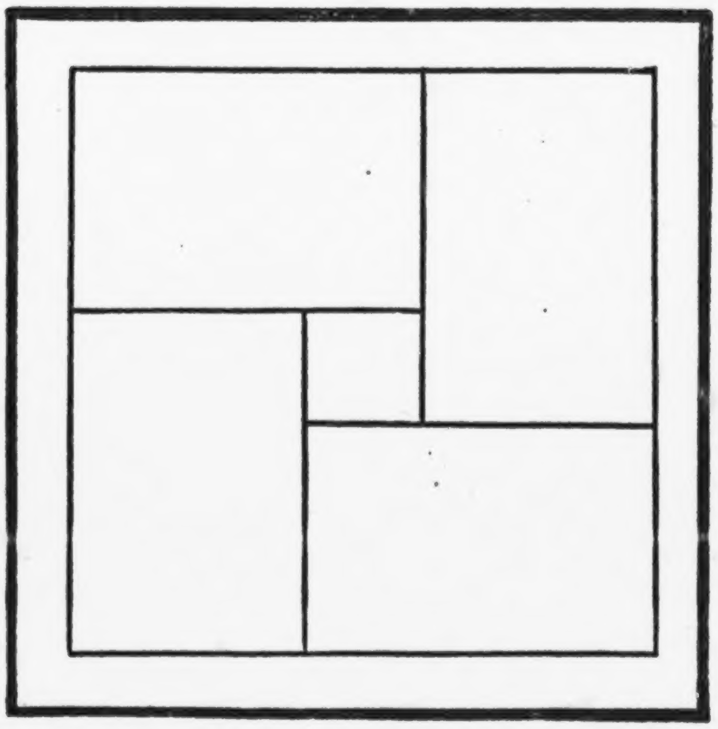
F. To make the game board, position the 4 game sheets at right angles to each other, and place them on a piece of poster board. The poster board should be 22" square. This will allow for a border on each side of the game sheets. (See the diagram below.)

Note:

You may notice a 3" square with an eagle inside, located on one of your stock card sheets. This was made to cover the center hole of the game, when the game sheets are in position.

Note:

When placing the game sheets on the poster board, make sure the starting space is in the lower left hand corner; the labor union space is in the upper left hand corner; the automation space is in the upper right hand corner; and the management space is in the lower right hand corner. This will position the game sheets correctly on the board.



AUTOMATION CARDS

AUTOMATION IS A METHOD OF INCREASING LIKE PRODUCTION AT A GREATER SPEED AND INCREASED ACCURACY AND WITH FEWER REJECTIONS.

MOVE AHEAD 3 SPACES

YOU ARE A NON UNION, UNSKILLED WORKER AND AUTOMATION HAS DISPLACED YOU - YOU MUST ATTEND LABOR UNION MEETINGS TO LEARN ABOUT PROTECTION OF YOUR WORKER RIGHTS.

MOVE BACK 8 SPACES.

AUTOMATION HAS DISPLACED YOUR JOB - YOU MUST NOW FIND WAYS OF PREPARING YOURSELF TO MEET INDUSTRY'S NEW DEMANDS.

MOVE BACK 3 SPACES

AUTOMATION REDUCES YOUR WORK LOAD AND GIVES YOU MORE LEISURE TIME. TAKE A VACATION AND MISS YOUR NEXT TURN.

AUTOMATION MAY BE DEFINED AS A SYSTEM OR METHOD IN WHICH MANY OR ALL OF THE PROCESSES OF PRODUCTION, MOVEMENT AND INSPECTION OF PARTS AND MATERIALS ARE AUTOMATICALLY PERFORMED OR CONTROLLED BY SELF - OPERATING MACHINERY, ELECTRONIC DEVICES, ETC.

AUTOMATED MACHINES OR SYSTEMS INCREASE YOUR TECHNICAL BACKGROUND - YOU ARE NOW MORE KNOWLEDGEABLE.

MOVE AHEAD 3 SPACES

AUTOMATION CARDS

AUTOMATED SYSTEMS IS RIGHT UP YOUR ALLEY - AND NOW YOU ARE RECOGNIZED AS A LEADER AND MANAGEMENT WANTS YOU FOR ONE OF THEIR WHITE COLLAR WORKERS. SORRY, BUT INCREASE PAY MEANS INCREASE RESPONSIBILITIES. MOVE BACK 3 SPACES

AUTOMATION PROMOTES SOCIAL, ECONOMIC, AND INDUSTRIAL CHANGES. YOU MUST RELOCATE, REEDUCATE, BECAUSE OF YOUR WORKER DISPLACEMENT.

COLLECT $500 NEGOTIABLE BONDS FROM EACH PLAYER

AUTOMATION STARTS TO PRODUCE MANY NEW JOB OPPORTUNITIES FOR THE RESEARCH AND DEVELOPMENT DIVISIONS IN INDUSTRY.

MOVE AHEAD 8 SPACES

AUTOMATION PROMISES GREATER PROFITS AND INCREASED PRODUCTION WHICH MEANS HIGHER PAY FOR THE WORKERS.

MOVE AHEAD 3 SPACES

AUTOMATION PROVIDES GREATER OPPORTUNITIES TO DEVELOP NEWER AND BETTER METHODS OF PRODUCTION.

MOVE AHEAD 3 SPACES

AUTOMATION REDUCES WORKER ACCIDENTS BY PROVIDING FOR MANY OPERATIONS WHICH ARE MECHANICALLY DONE WITH LESS HANDLING AND PHYSICAL WORK AS BEFORE. YOU GET A FREE ROLL, THROW DICE AGAIN

LABOR UNION CARDS

THE NEED FOR LABOR UNIONS WERE EVIDENT WHEN MANAGEMENT FAILED TO SATISFY WORKERS NEEDS.

LABOR UNIONS WERE INSTRUMENTAL IN LOWERING THE WORKER HOURS PER WEEK FROM 70 TO 80 HOURS PER WEEK IN THE EARLY 1900'S, TO 40 HOURS PER WEEK IN THE MIDDLE 1900'S.

A SHORTER WORK WEEK GIVES THE WORKER MORE CHANCE FOR RECREATION, PLEASURE, AMUSEMENT, COMFORT, CONVIENCE, AND TO BE WITH THEIR FAMILIES.

THE NEW DEAL LEGISLATION OF THE 1930'S INCREASED MANAGEMENT, UNION AND WORKER RELATIONS.

THE LABOR UNIONS STRIVE TO GET MEDICAL BENEFITS, SICK PAY, VACATIONS PAY AND OTHER NEEDED BENEFITS FOR THE WORKER.

LABOR UNIONS RECOGNIZE THE NEED FOR OVER TIME PAY, BONUSES, AND INCREASED PAY RAISES WITHIN EACH INDUSTRY.

LABOR UNION CARDS

LABOR UNIONS HAVE BEEN INSTRUMENTAL IN GIVING THE WORKER A VOICE IN MANAGEMENT, PRACTICE AND PROCEDURES.

LABOR UNIONS HAVE PROTECTED AND GIVEN MORE JOB SECURITY TO THE WORKER.

LABOR UNIONS HAVE DEFINED WORKERS JOBS AND PRACTICES IN THE INDUSTRIES. (EXAMPLE: A PLUMBER CANNOT DO ELECTRICAL WORK.)

LABOR UNIONS WERE INSTRUMENTAL IN PROTECTING WORKERS RIGHTS ON LAY-OFFS, DISCHARGE OF JOB AND STRIKERS BENEFITS FOR THE GOOD OF THE WORKER.

LABOR UNIONS DEVELOP WELL DEFINED SCALE WAGES FOR EACH OCCUPATION. (EXAMPLE: ELECTRICIAN MIGHT RECEIVE $10 PER HOUR FOR CERTAIN JOBS - WHEREAS, A NON - SKILLED WORKER MIGHT ONLY RECEIVE $5 PER HOUR.

LABOR UNIONS WERE INSTRUMENTAL IN KEEPING OUT NON-SKILLED LABORERS FOR SKILL JOBS AND DEVELOPING THE CLOSED SHOP METHOD (UNION MEMBERS ONLY.)

FINANCIAL CARDS

YOU FIND THAT YOU NEED COLLATERAL TO ADD NEW SYSTEMS FOR PRODUCTION.

COLLECT $1,000 NEGOTIABLE BONDS

YOU HAVE ACQUIRED SOME INDUSTRIES BUT LATER FIND YOU HAVE A MONOPOLY ON A CERTAIN PRODUCT - THE LAW DOES NOT PERMIT THIS SO YOU MUST SELL ONE OF YOUR INDUSTRIES.

COLLECT $1,000 NEGOTIABLE BONDS

YOU JUST ACQUIRED SOME BAD STOCK AND YOU ARE LOSING YOUR SHIRT - YOU MUST DECLARE BANKRUPTCY.

PAY $1,000 NEGOTIABLE BONDS

YOU JUST DISCOVERED THAT THE IRON ORE FIELD THAT YOU BOUGHT HAS GOT HIGH QUALITY SILVER DEPOSITS.

COLLECT $1,000 NEGOTIABLE BONDS

INFLATION HAS CUT INTO YOUR PROFITS - HENCE YOU HAD TO LAY OFF WORKERS.

PAY $1,000 NEGOTIABLE BONDS

YOU JUST OPENED AN OVERSEAS OFFICE AND YOUR TRADE PICKED UP. YOUR STOCKS ON THE STOCK MARKET WENT UP.

COLLECT $500 NEGOTIABLE BONDS

FINANCIAL CARDS

YOU HAVE JUST RECEIVED A SUBSTANTIAL GOVERNMENT CONTRACT - NOW YOUR PRODUCTION WILL BE UP AND OVERHEAD WILL BE AT A MINIMUM.

COLLECT $1,000 NEGOTIABLE BONDS

RESEARCH AND DEVELOPMENT IN YOUR INDUSTRY HAS JUST INFORMED YOU THAT THEY HAVE MADE A STARTLING DISCOVERY.

COLLECT $1,000 NEGOTIABLE BONDS AND MOVE AHEAD 1 SPACE

QUALITY CONTROL HAD A CHANGE OVER OF TESTING INSTRUMENTS BECAUSE THE OLD ONES WERE NOT ACCURATE.

PAY $500 NEGOTIABLE BONDS

YOU HAD A SAFE YEAR IN YOUR INDUSTRY WITH VERY FEW WORKER ACCIDENTS - YOUR INSURANCE COMPANY JUST LOWERED YOUR PREMIUM.

COLLECT $100 NEGOTIABLE BONDS

YOU JUST HAD TO CALL BACK YOUR LAST SHIPMENT OF PRODUCTS BECAUSE OF A MALFUNCTION ON THE ASSEMBLY LINE. QUALITY CONTROL MISSED IT.

PAY $100 NEGOTIABLE BONDS

YOU JUST DEVELOPED A REVOLUTIONARY DESIGN FOR YOUR PRODUCT, AND WHEN IT HIT THE MARKET IT SOLD LIKE WILDFIRE.

COLLECT $1,000 NEGOTIABLE BONDS

MANAGEMENT CARDS

MANAGEMENT DEVELOPED THE APPRENTICE SYSTEM WITH THE CO-OPERATION OF LABOR UNIONS, FOR THE DEVELOPMENT OF MORE SKILLED WORKERS.

MOVE AHEAD 5 SPACES

QUALITY CONTROL WAS DEVELOPED FOR THE PROTECTION OF INDUSTRY FOR QUALITY PRODUCTS, FOR MANAGEMENT, AND WORKER CONTROL.

MANAGEMENT AND LABOR UNIONS WORKED TOGETHER IN DEVELOPING VACATION PAY AND WORKMANS COMPENSATION FOR ACCIDENTS ON THE JOB.

THE GOVERNMENT FINDS YOU GUILTY OF BREAKING AN ANTI-TRUST LAW. YOU ARE FINED $1,000 IN NEGOTIABLE BONDS.

YOU HAVE JUST HAD A PROXY FIGHT (CONTROL OF INDUSTRY STOCK) AND YOU LOST - TURN OVER ONE INDUSTRY, OF YOUR CHOICE, TO FINANCE.

YOU HAVE JUST BEEN GIVEN POWER OF ATTORNEY TO CHOOSE ANY INDUSTRY WHICH IS OWNED BY FINANCE, FREE OF CHARGE.

MANAGEMENT CARDS

MANAGEMENT ACCEPTS LABOR UNIONS PROPOSALS FOR INCREASE PAY.

MOVE AHEAD 3 SPACES.

MANAGEMENT DECLINES LABOR UNIONS PROPOSALS FOR INCREASE BENEFITS.

MOVE BACK 3 SPACES.

MANAGEMENT INCREASES JOB OPPORTUNITIES - WHICH MEANS MORE WORKERS, MORE POSITIONS AVAILABLE.

MOVE AHEAD 8 SPACES.

MANAGEMENT REALIZES THE NEED FOR SAFETY EQUIPMENT AND SAFER WORKING CONDITIONS - THIS MEANS LESS WORKER ACCIDENTS.

MANAGEMENT RECOGNIZES THE NEED FOR ON THE JOB TRAINING, INCREASE EDUCATION FOR WHITE COLLAR WORKERS POSITIONS.

MANAGEMENT THROUGH CO-OPERATION WITH THE LABOR UNIONS DEVELOP ADMINSTRATIVE WORKER POSITIONS SUCH AS, FOREMAN, GANG BOSS, AND CHIEF.

FOOD PROCESSING STOCKS **** COST OF PRODUCT $1,000 NEG. BONDS **** WITH BOLT $2,000 " NUT $4,000 " WASHER $6,000	PRINTING AND PUBLISHING STOCKS **** COST OF PRODUCT $1,000 NEG. BONDS **** WITH BOLT $2,000 " NUT $4,000 " WASHER $6,000	METAL STOCKS **** COST OF PRODUCT $1,000 NEG. BONDS **** WITH BOLT $2,000 " NUT $4,000 " WASHER $6,000	PETROLEUM STOCKS **** COST OF PRODUCT $1,000 NEG. BONDS **** WITH BOLT $2,000 " NUT $4,000 " WASHER $6,000
CONSTRUCTION STOCKS **** COST OF PRODUCT $1,000 NEG. BONDS **** WITH BOLT $2,000 " NUT $4,000 " WASHER $6,000	FABRIC STOCKS **** COST OF PRODUCT $1,000 NEG. BONDS **** WITH BOLT $2,000 " NUT $4,000 " WASHER $6,000	RUBBER STOCKS **** COST OF PRODUCT $500 NEG. BONDS **** WITH BOLT $1,000 " NUT $2,000 " WASHER $3,000	FORESTRY STOCKS **** COST OF PRODUCT $500 NEG. BONDS **** WITH BOLT $1,000 " NUT $2,000 " WASHER $3,000
METALLIC STOCKS **** COST OF PRODUCT $500 NEG. BONDS **** WITH BOLT $1,000 " NUT $2,000 " WASHER $3,000	AGRICULTURE STOCKS **** COST OF PRODUCT $500 NEG. BONDS **** WITH BOLT $1,000 " NUT $2,000 " WASHER $3,000	NON-METALLIC STOCKS **** COST OF PRODUCT $500 NEG. BONDS **** WITH BOLT $1,000 " NUT $2,000 " WASHER $3,000	HIGHWAY STOCKS **** COST OF PRODUCT $1,500 NEG. BONDS **** WITH BOLT $3,000 " NUT $6,000 " WASHER $9,000

RAILROAD
STOCKS
****
COST OF PRODUCT
$1,500 NEG. BONDS
****
WITH BOLT $3,000
" NUT $6,000
" WASHER $9,000

PIPELINE
STOCKS
****
COST OF PRODUCT
$1,500 NEG. BONDS
****
WITH BOLT $3,000
" NUT $6,000
" WASHER $9,000

AIR
TRANSPORTATION
STOCKS
****
COST OF PRODUCT
$1,500 NEG. BONDS
****
WITH BOLT $3,000
" NUT $6,000
" WASHER $9,000

WATER
TRANSPORTATION
STOCKS
****
COST OF PRODUCT
$1,500 NEG. BONDS
****
WITH BOLT $3,000
" NUT $6,000
" WASHER $9,000

APPLIANCE
REPAIR
STOCKS
****
COST OF PRODUCT
$2,000 NEG. BONDS
****
WITH BOLT $4,000
" NUT $8,000
" WASHER $12,000

ELECTRONICS
REPAIR
STOCKS
****
COST OF PRODUCT
$2,000 NEG. BONDS
****
WITH BOLT $4,000
" NUT $8,000
" WASHER $12,000

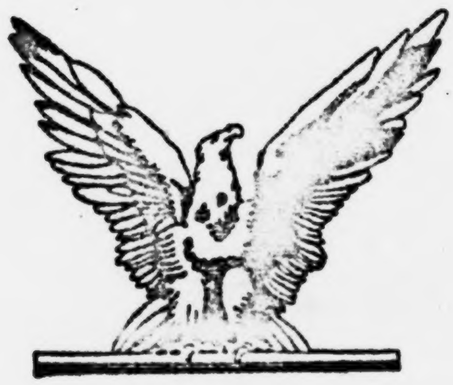
AUTOMOTIVE
REPAIR
STOCKS
****
COST OF PRODUCT
$2,000 NEG. BONDS
****
WITH BOLT $4,000
" NUT $8,000
" WASHER $12,000

TOOL AND DIE
REPAIR
STOCKS
****
COST OF PRODUCT
$2,000 NEG. BONDS
****
WITH BOLT $4,000
" NUT $8,000
" WASHER $12,000

CONSTRUCTION,
PLUMBING, ETC.
REPAIR STOCKS
****
COST OF PRODUCT
$2,000 NEG. BONDS
****
WITH BOLT $4,000
" NUT $8,000
" WASHER $12,000

NOT TO BE USED
IN THE GAME

CUT OUT THIS 3" SQUARE AND PLACE IT IN THE CENTER OF THE GAME BOARD.



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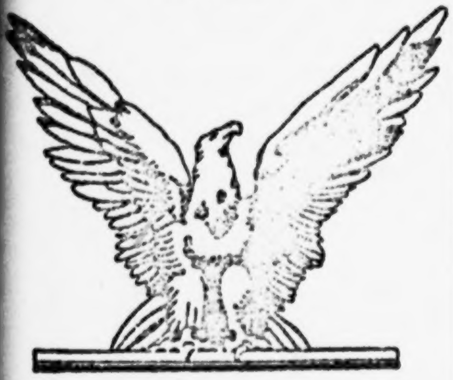

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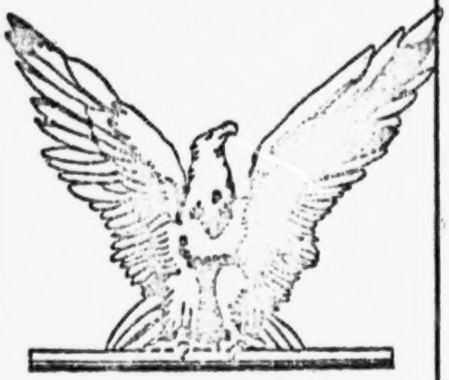

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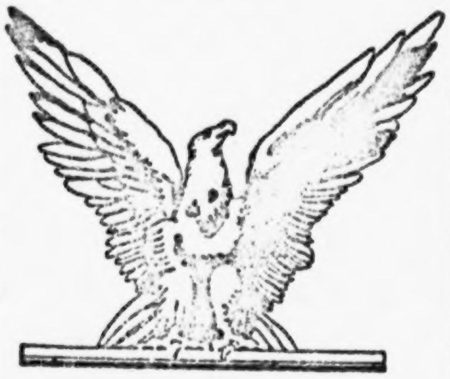

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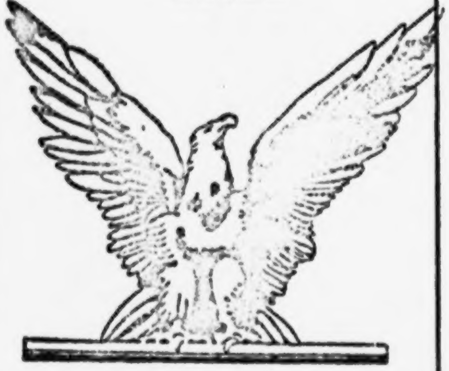

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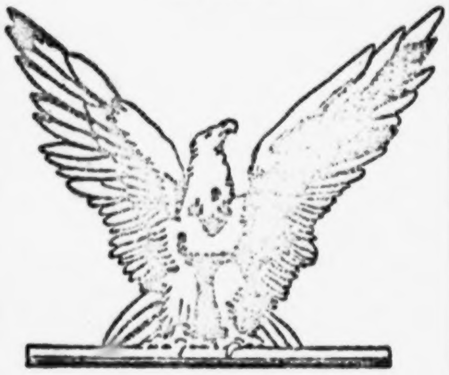

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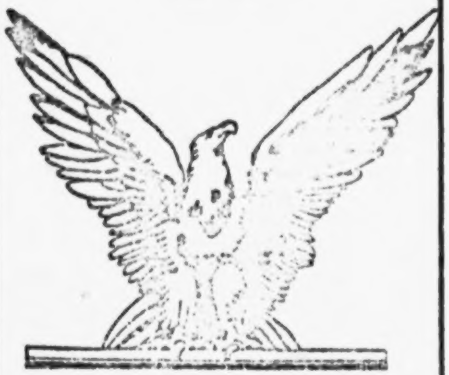

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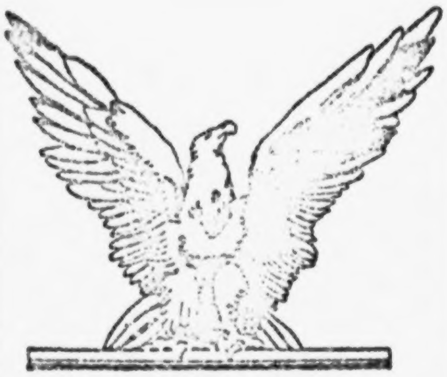

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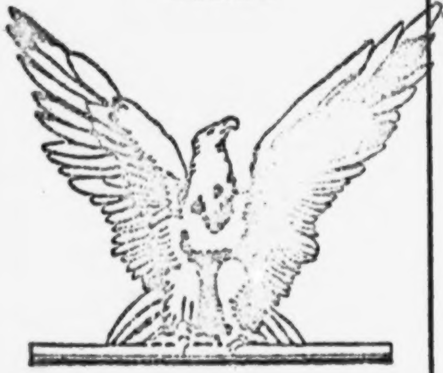

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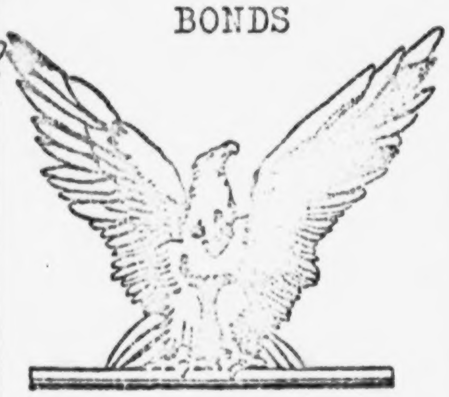

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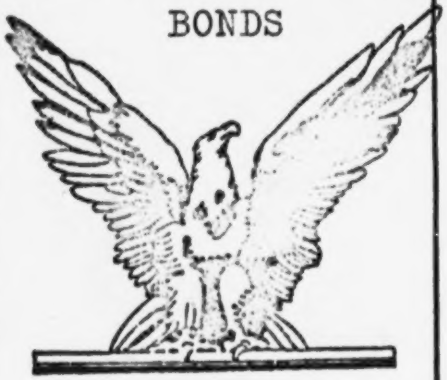

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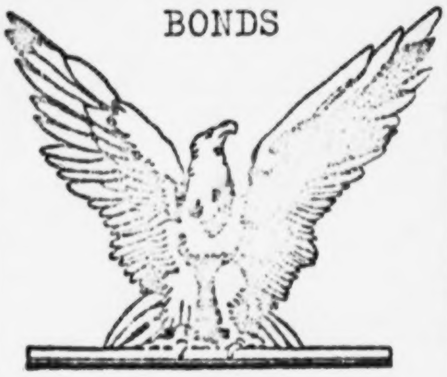

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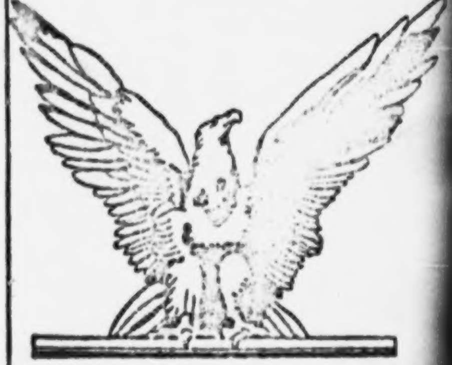

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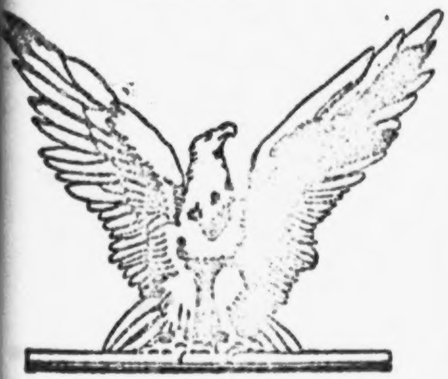

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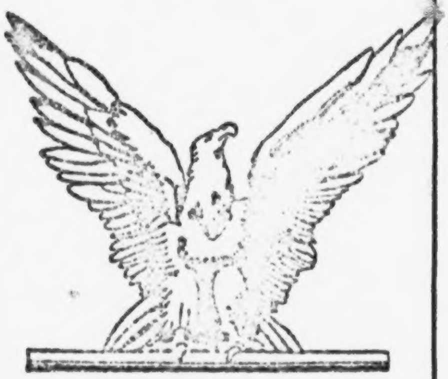

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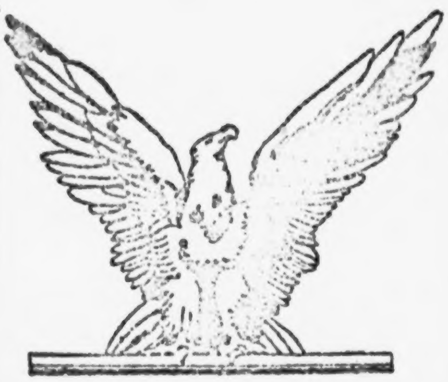

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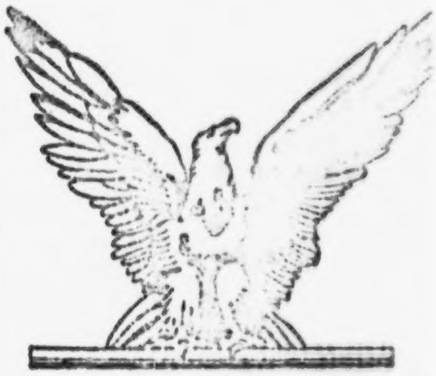

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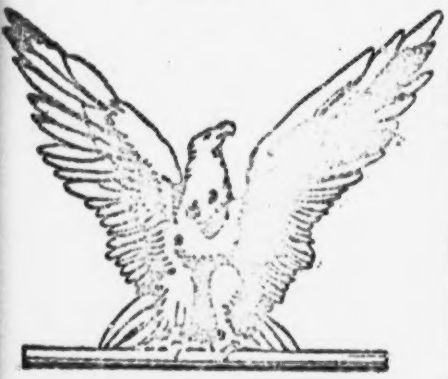

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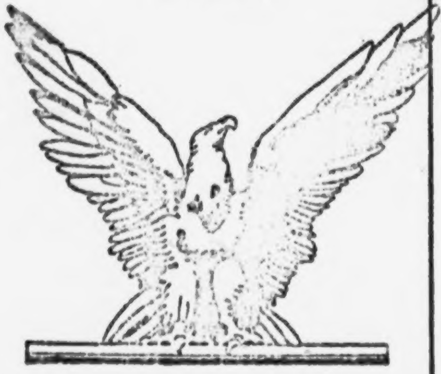

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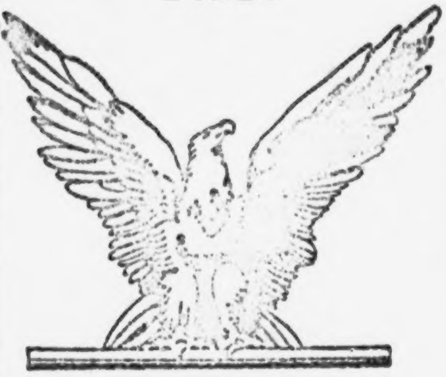

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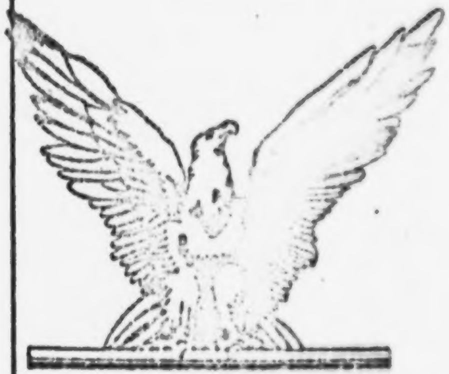

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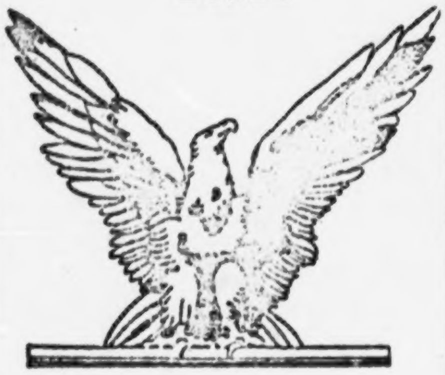

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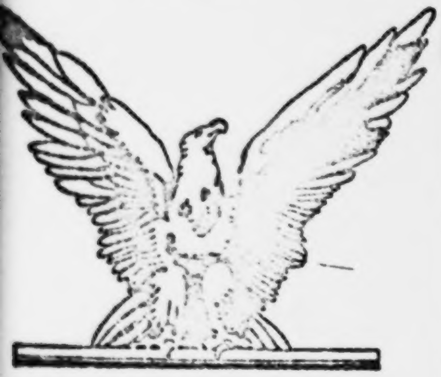

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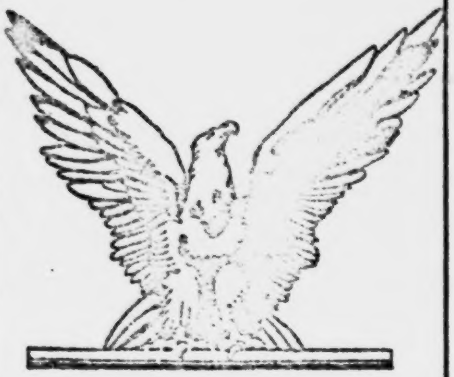

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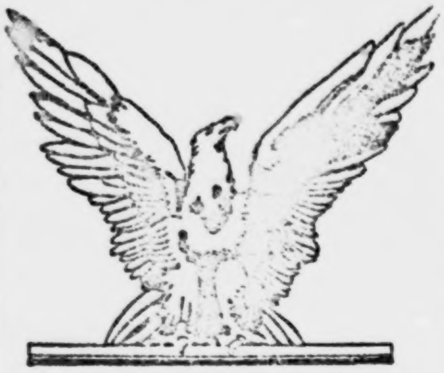

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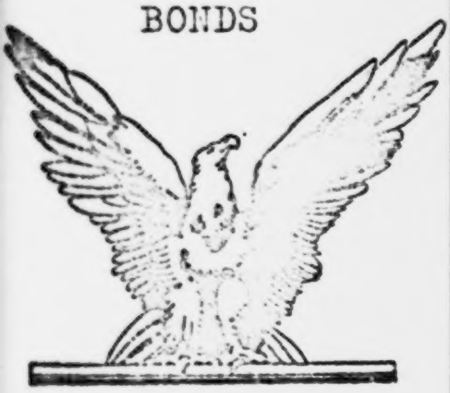

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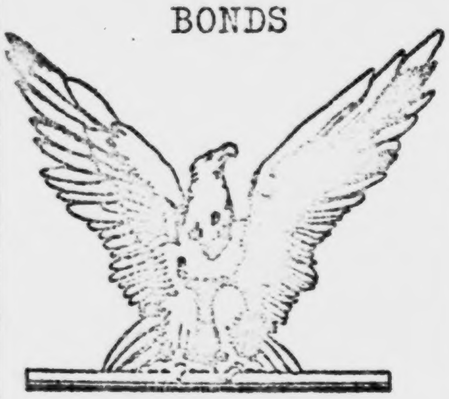

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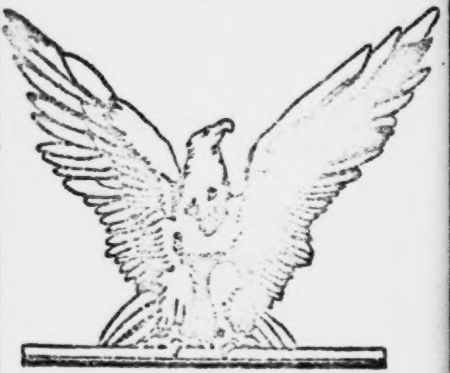

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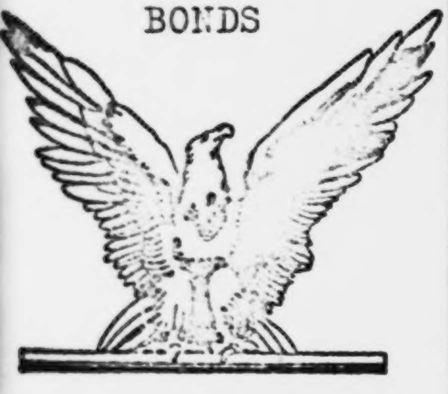

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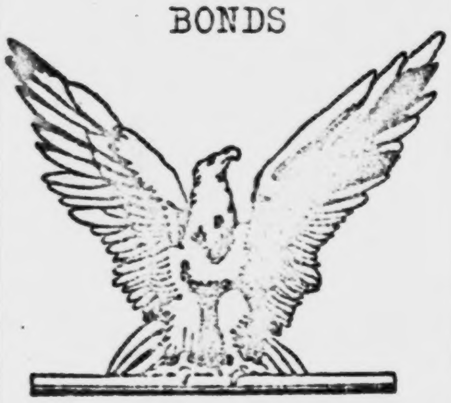

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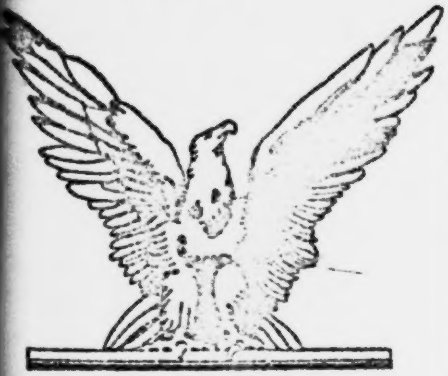

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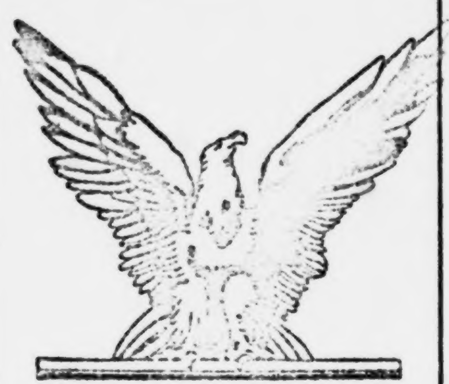

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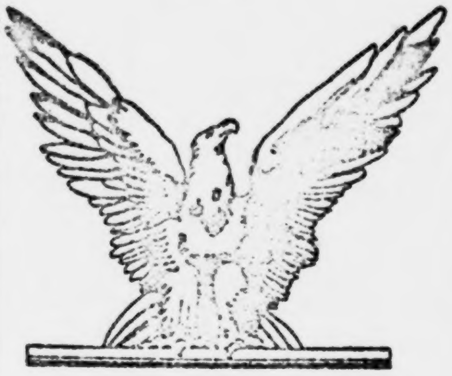

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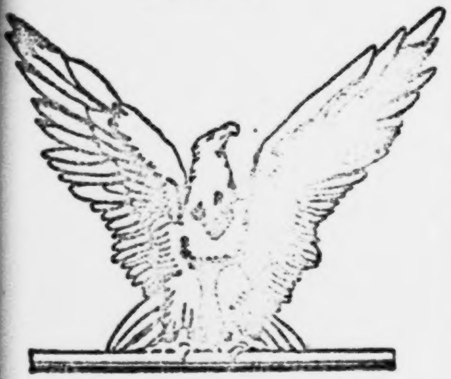

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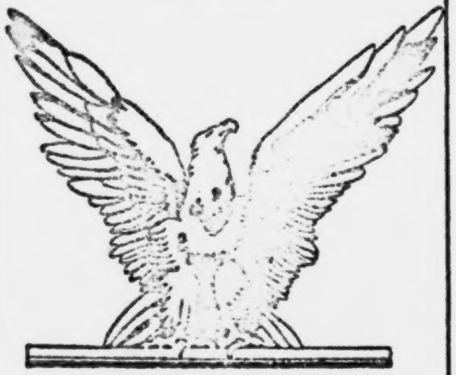

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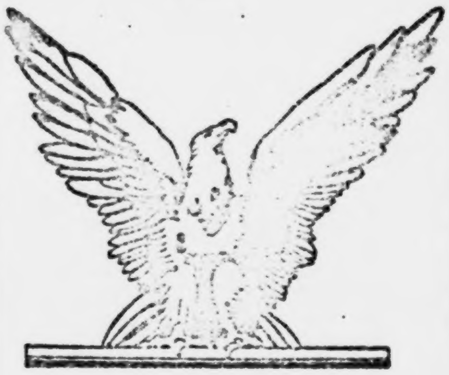

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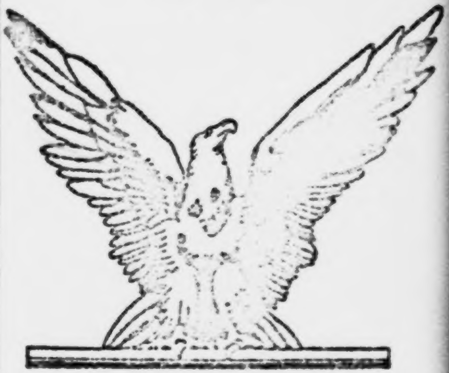

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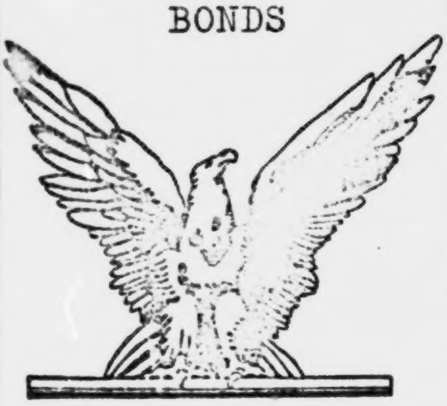

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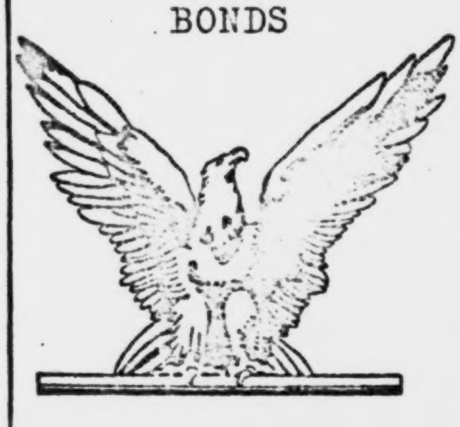

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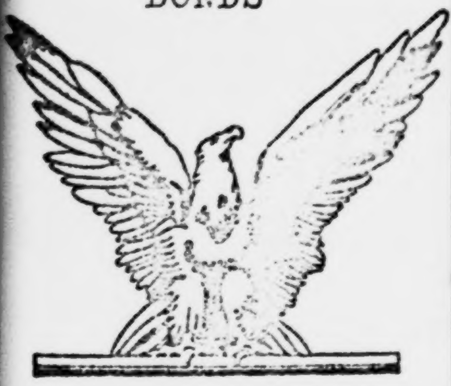

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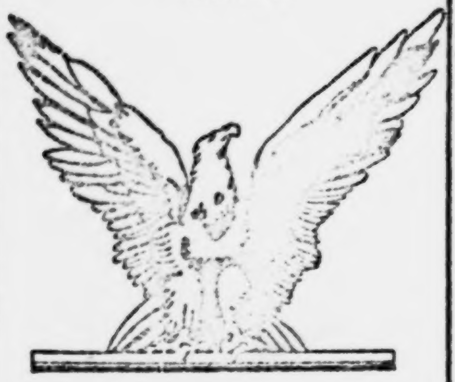

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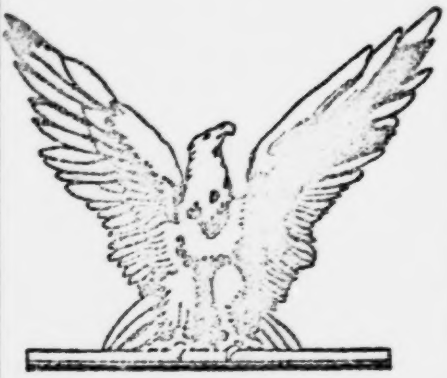

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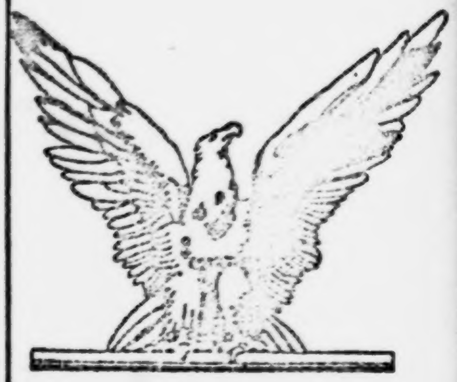

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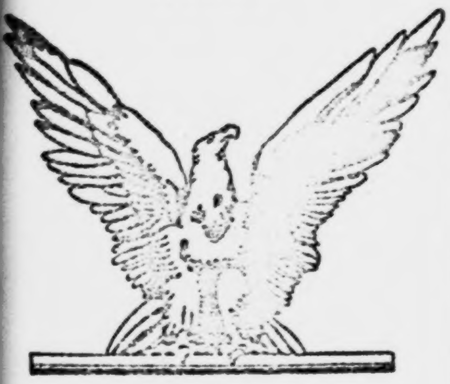

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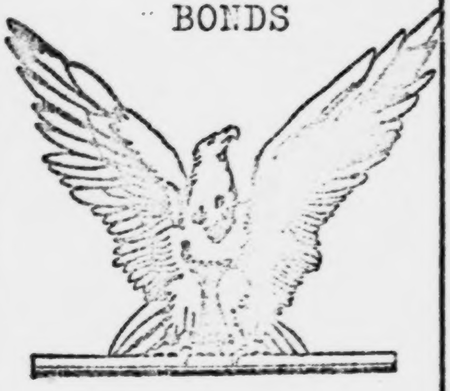

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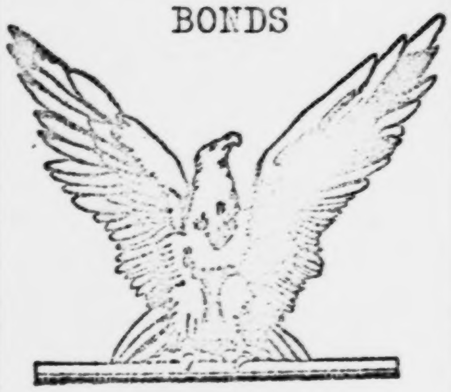

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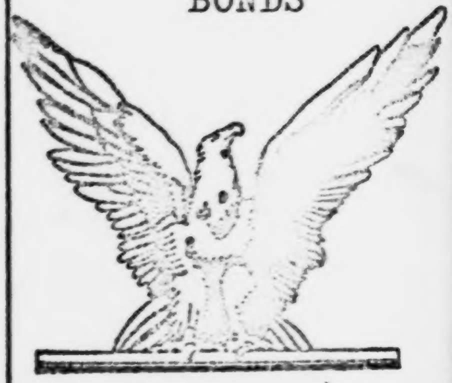

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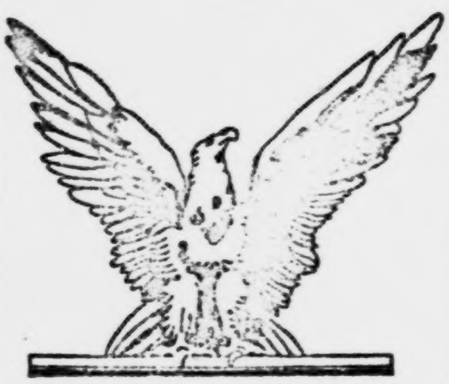

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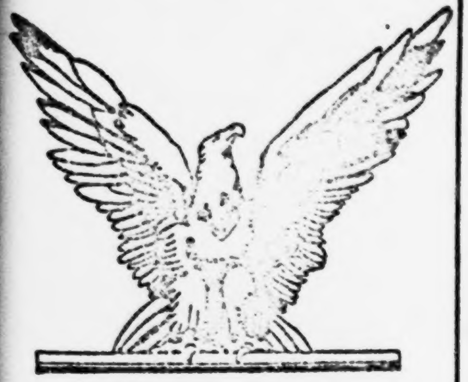

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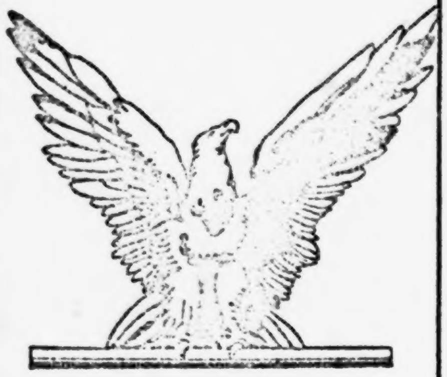

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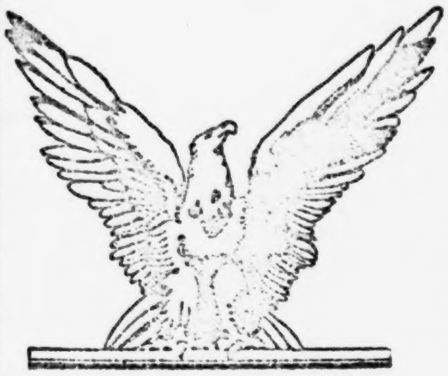

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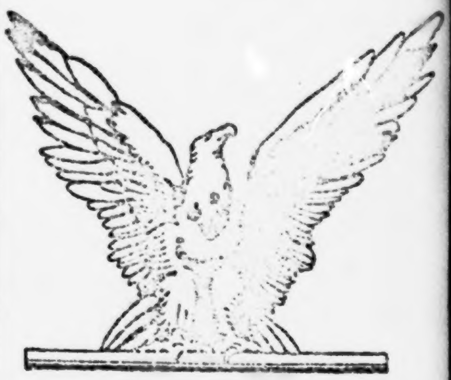

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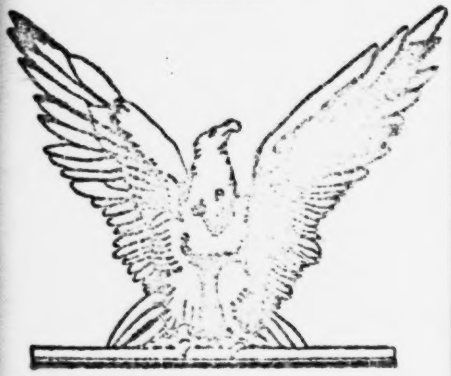

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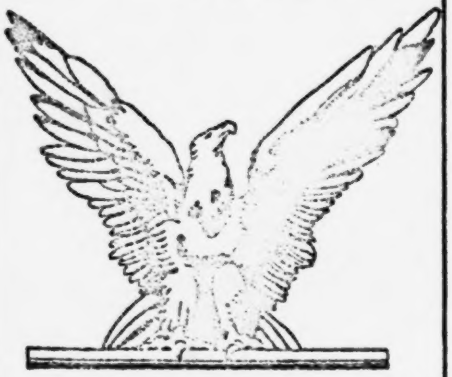

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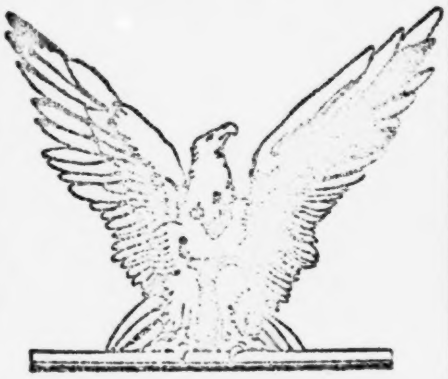

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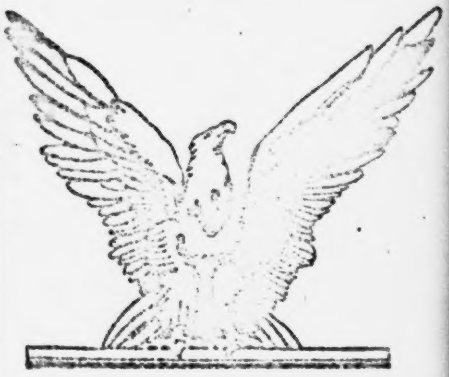

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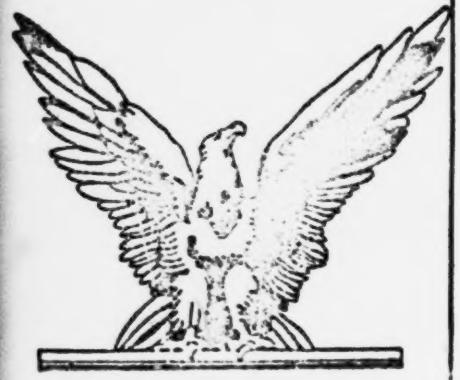

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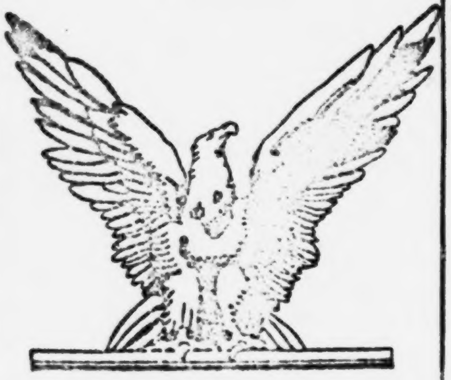

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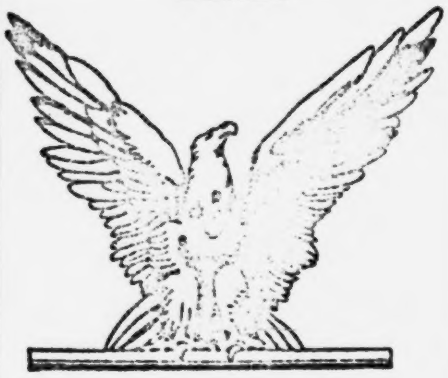

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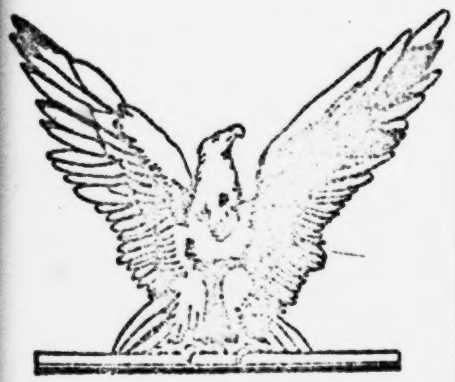

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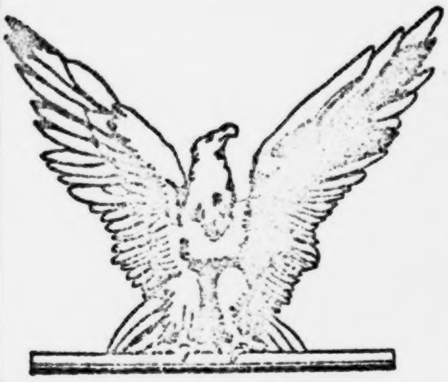

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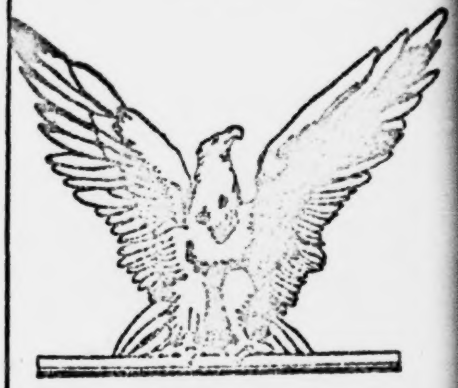

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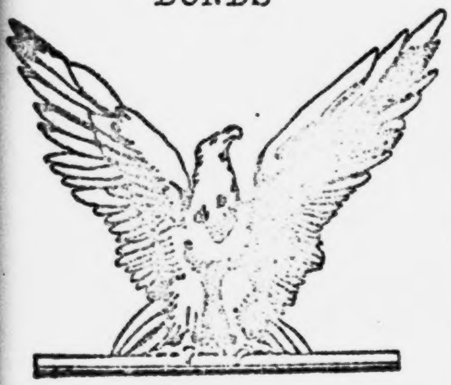

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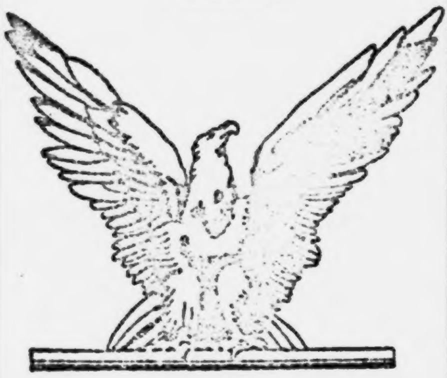

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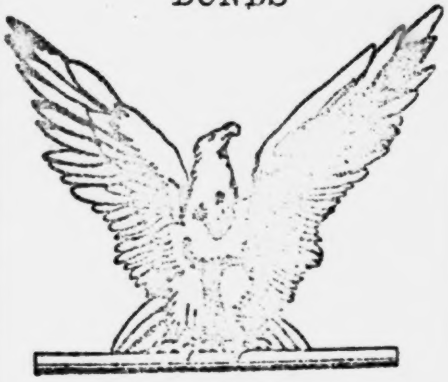

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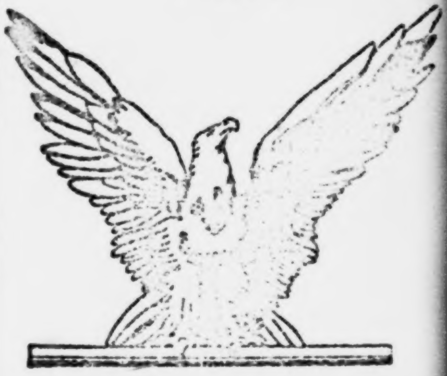

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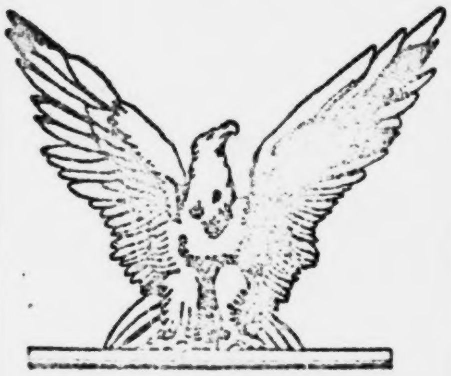

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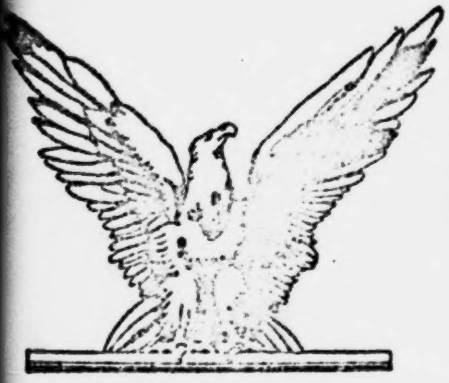

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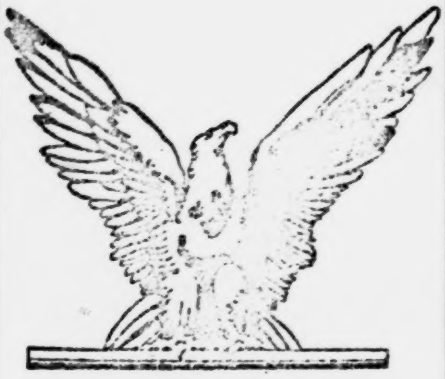

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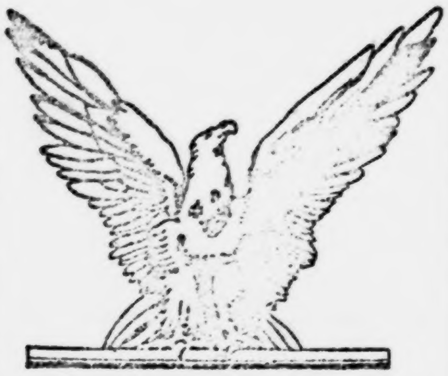

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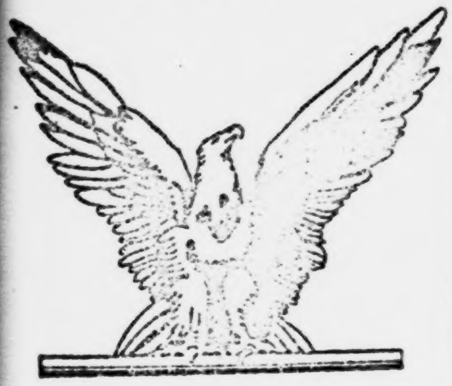

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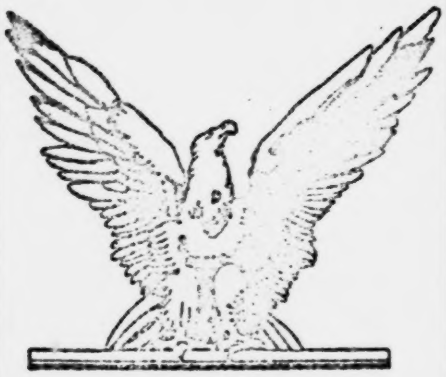

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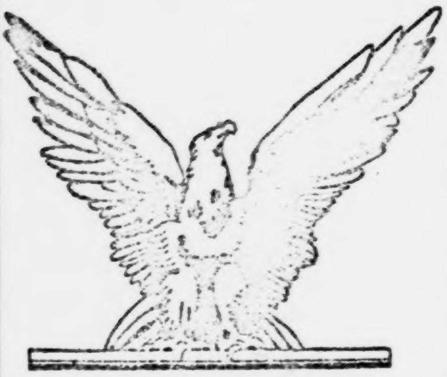

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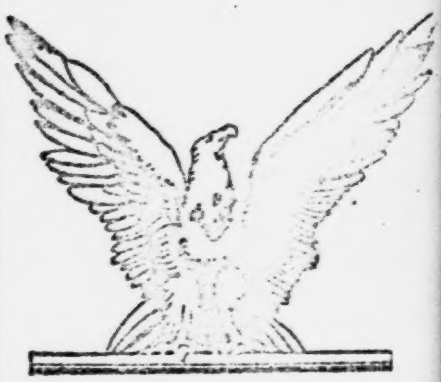

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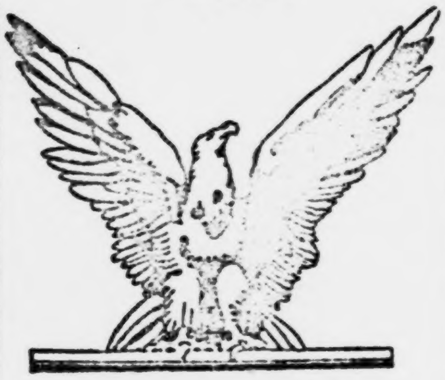

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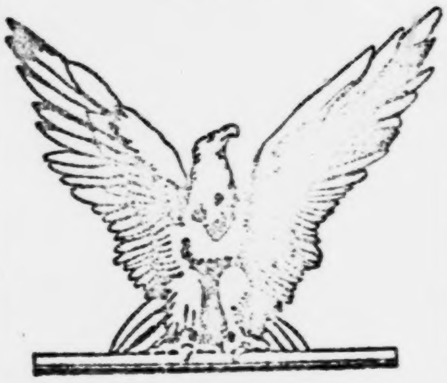

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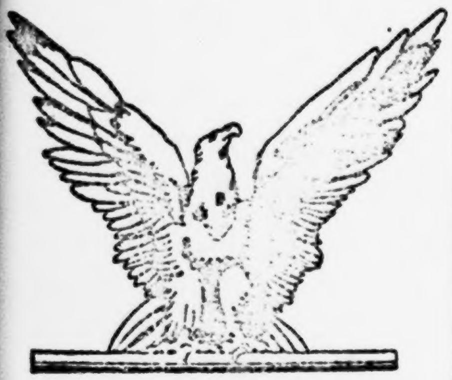

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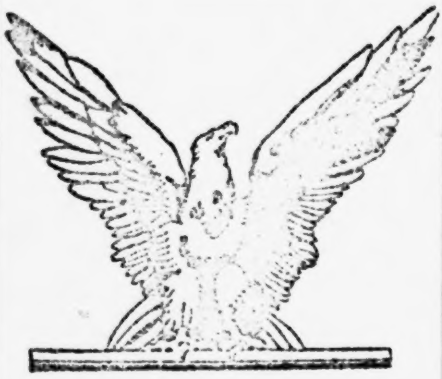

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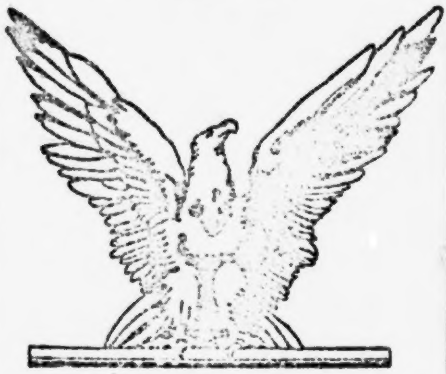

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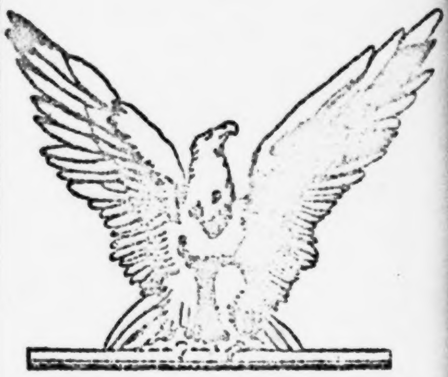

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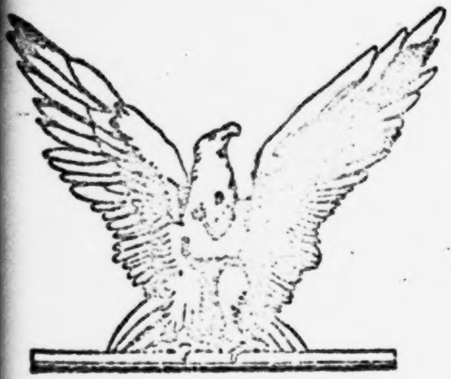

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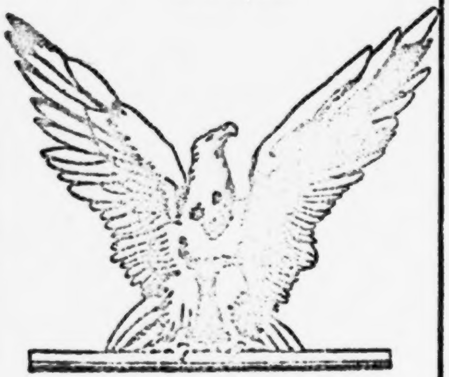

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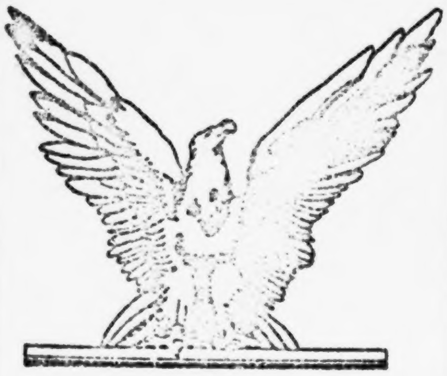

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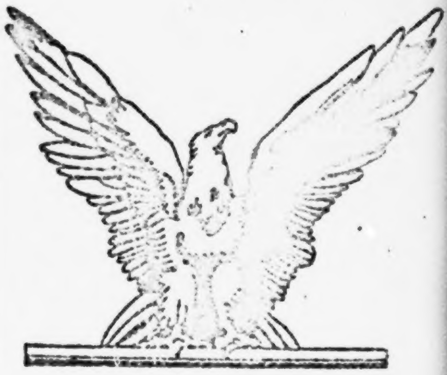

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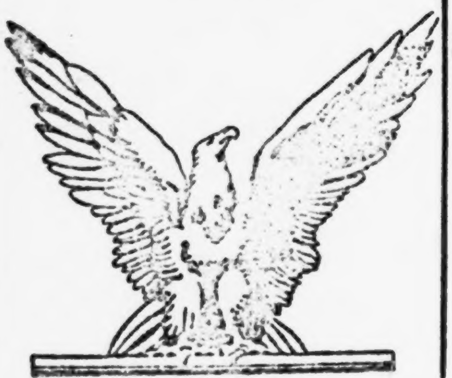

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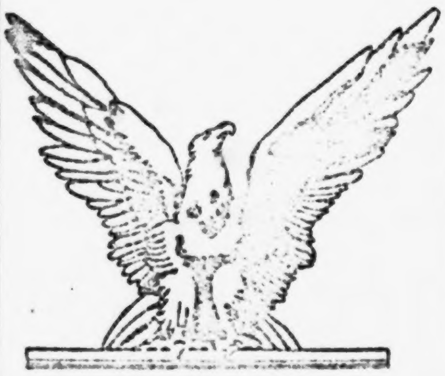

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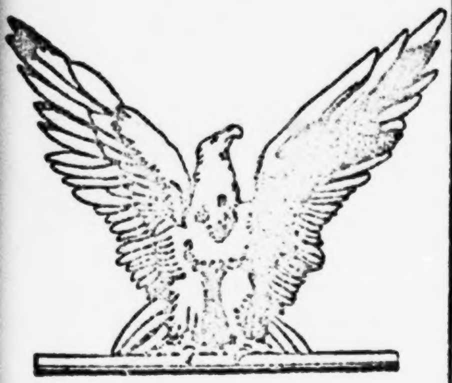
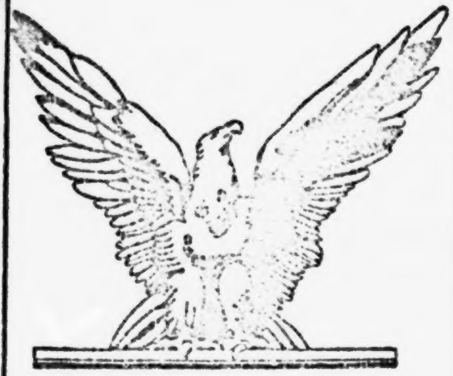
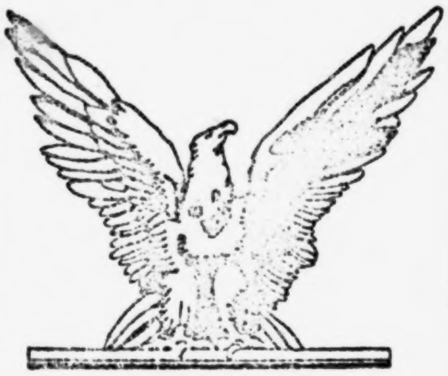
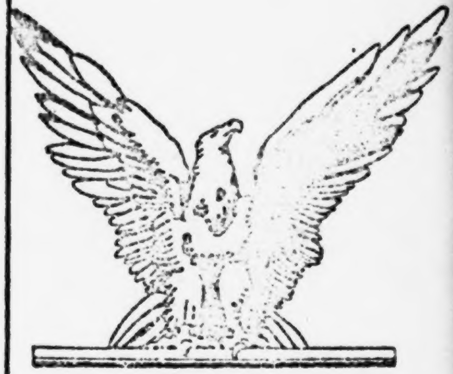
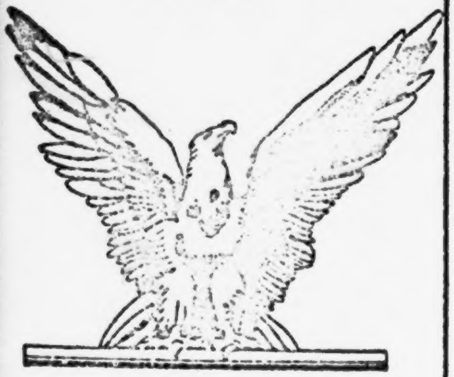
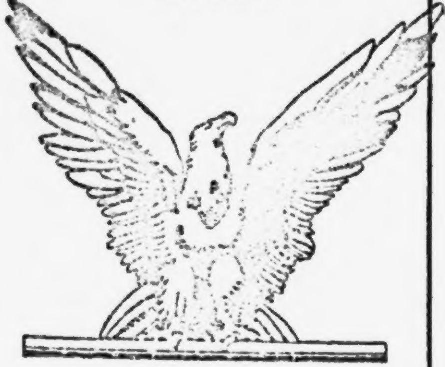
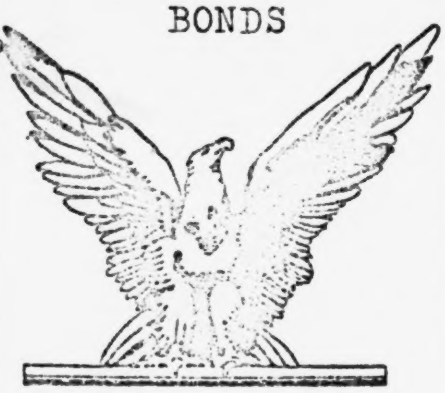
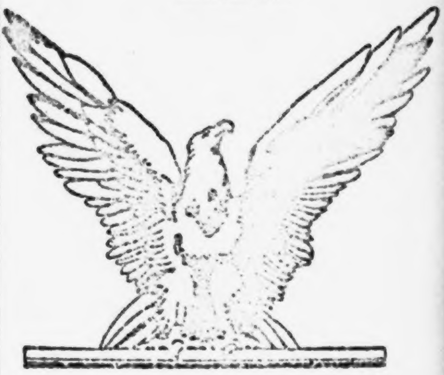
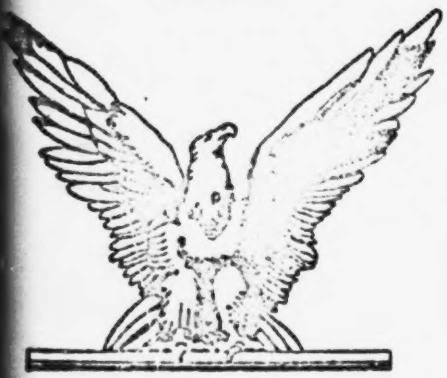
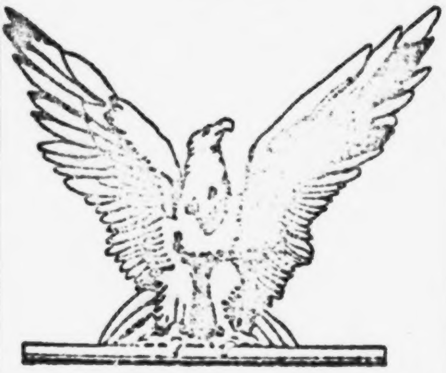
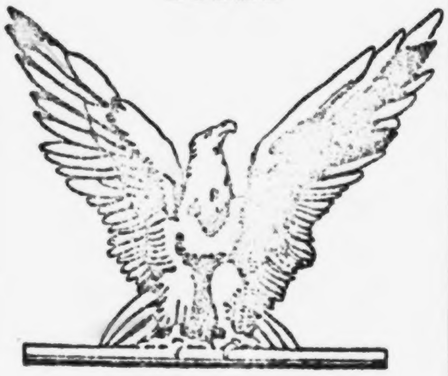
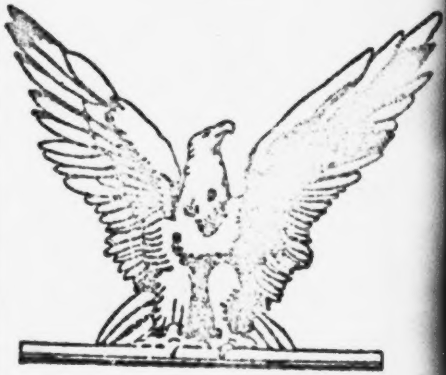
NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000
NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000
NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000	NEGOTIABLE BONDS  $1,000

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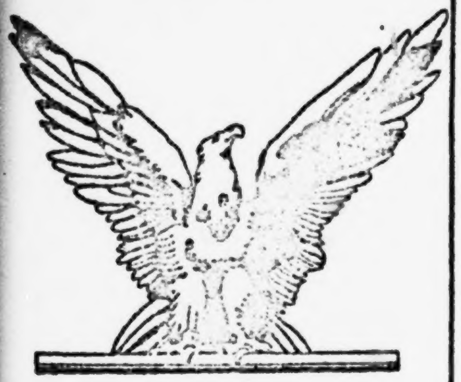

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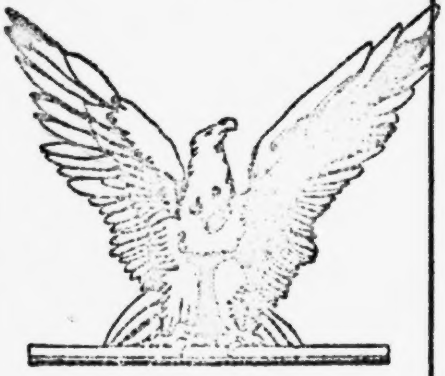

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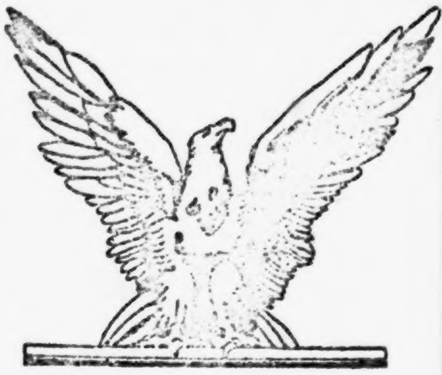

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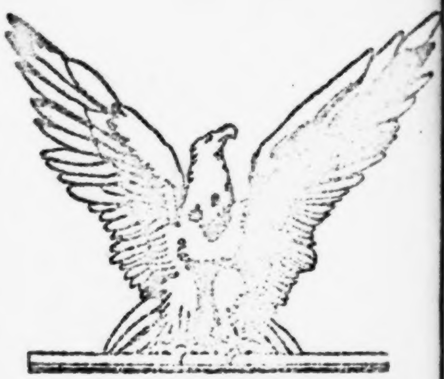

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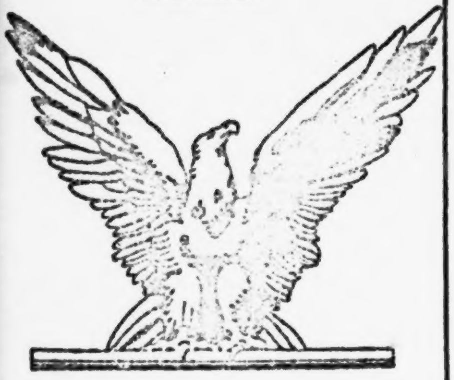

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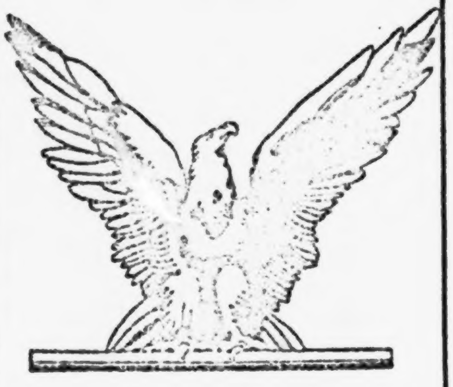

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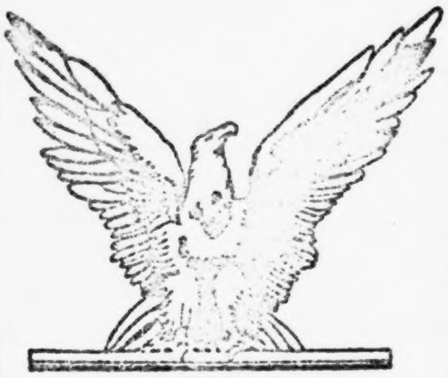

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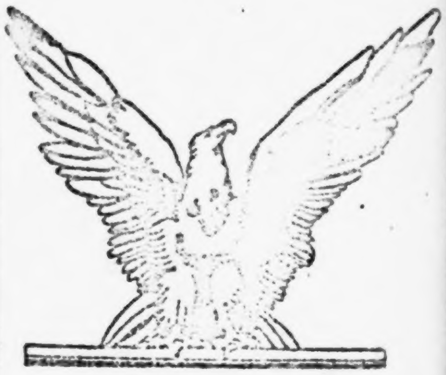

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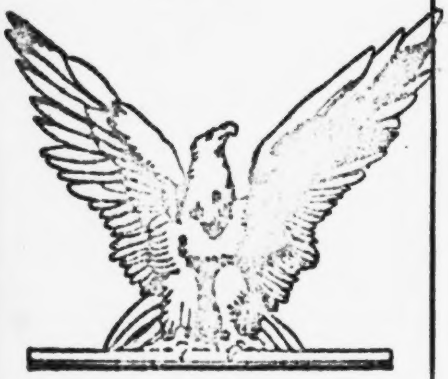

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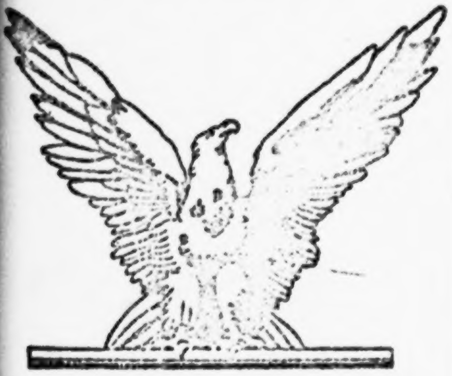

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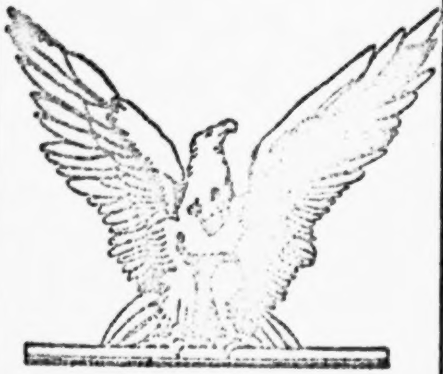

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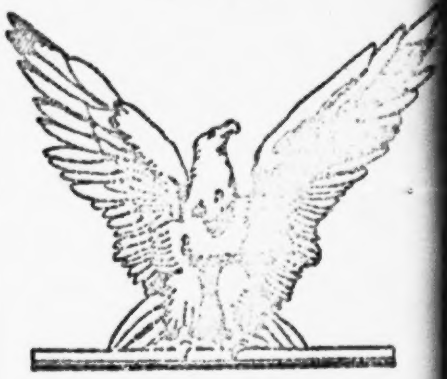

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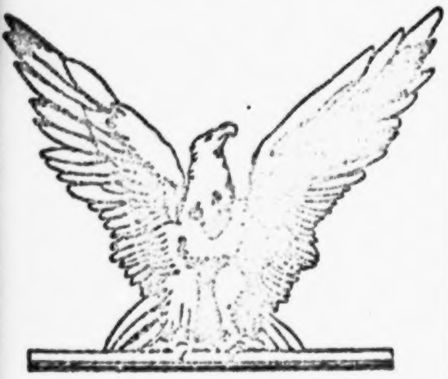

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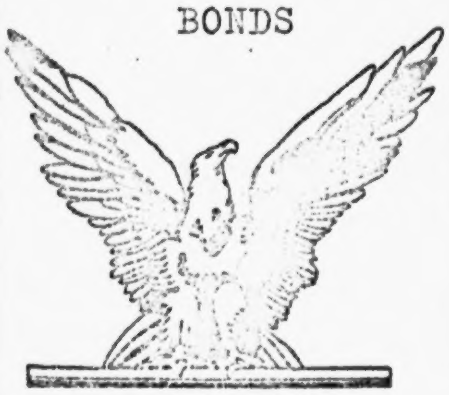

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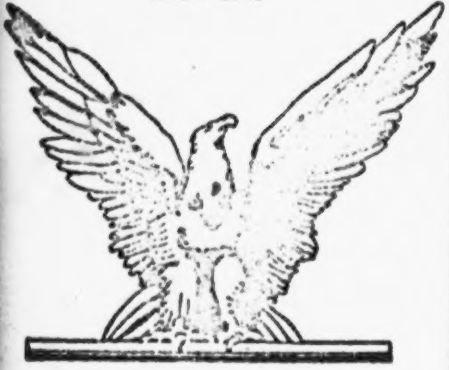

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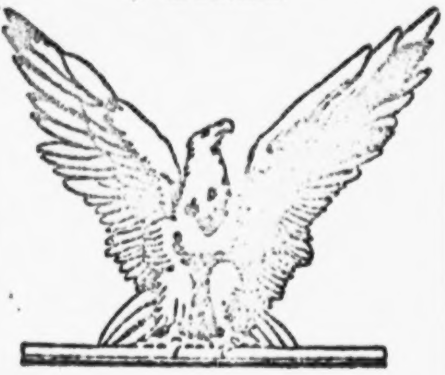

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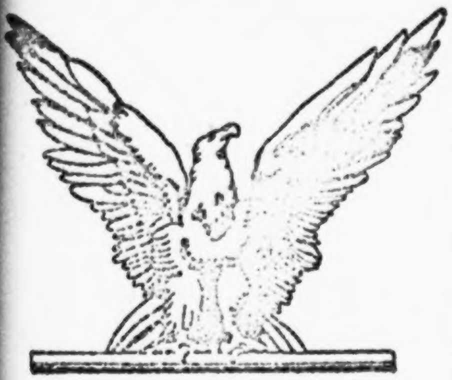

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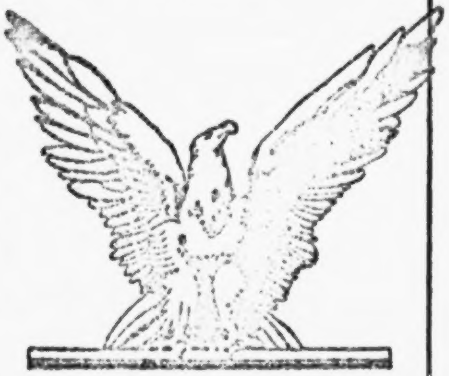

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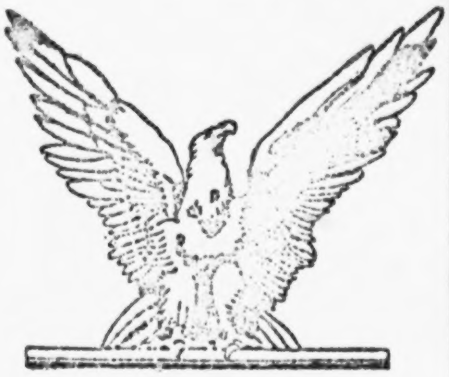

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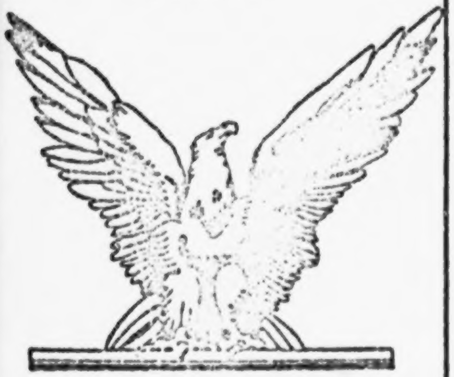

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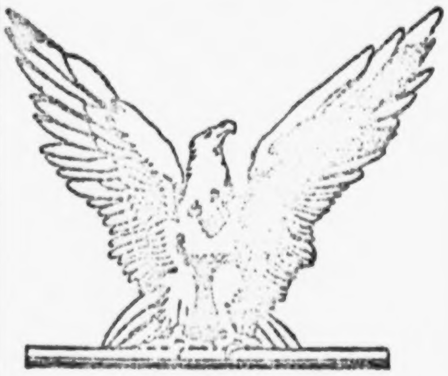

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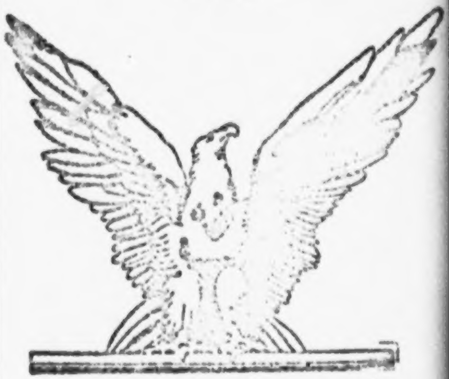

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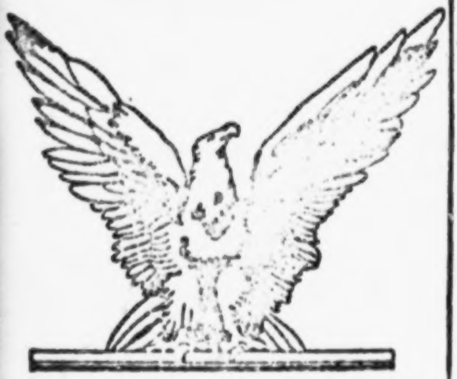

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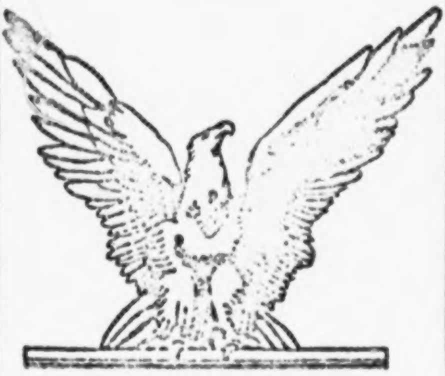

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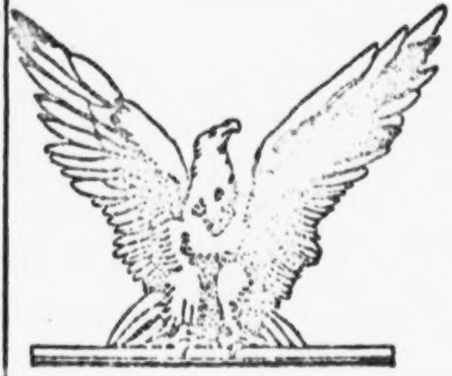

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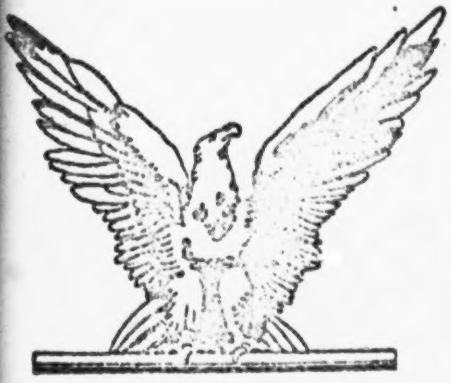

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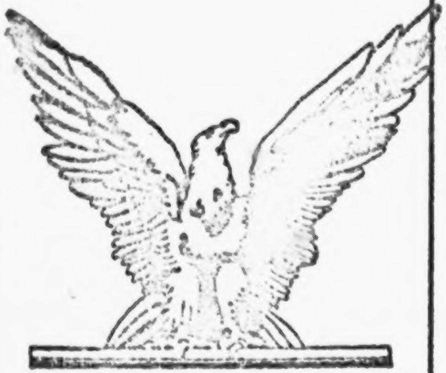

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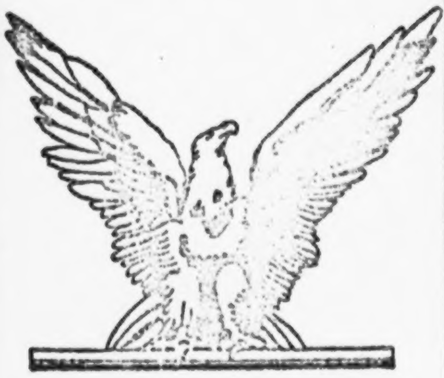

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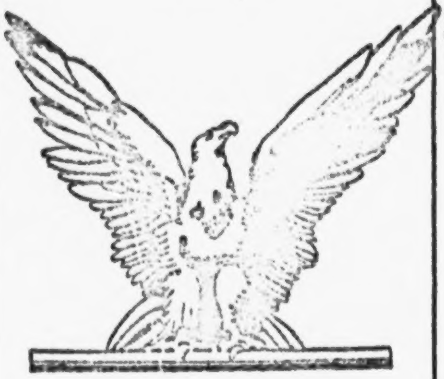

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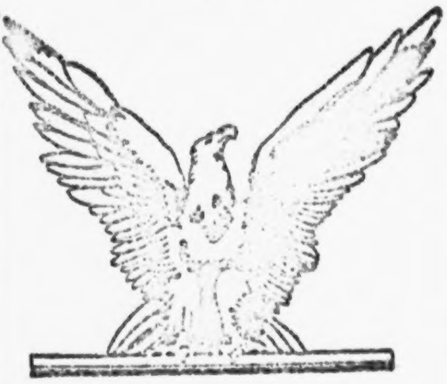

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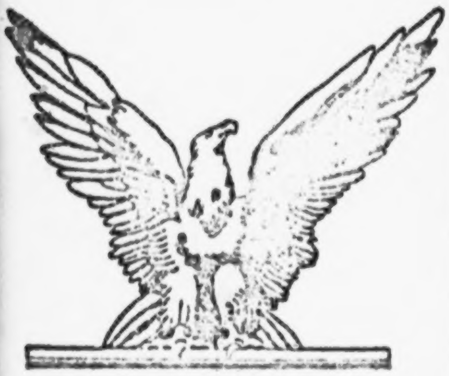

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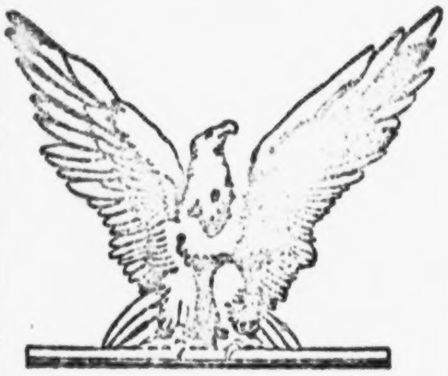

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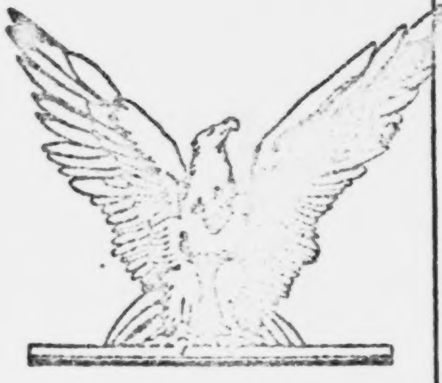

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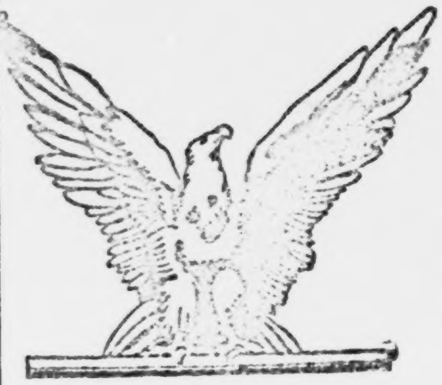

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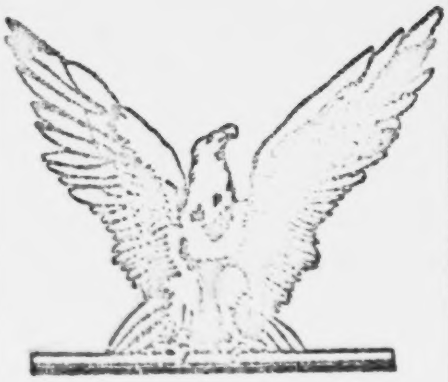

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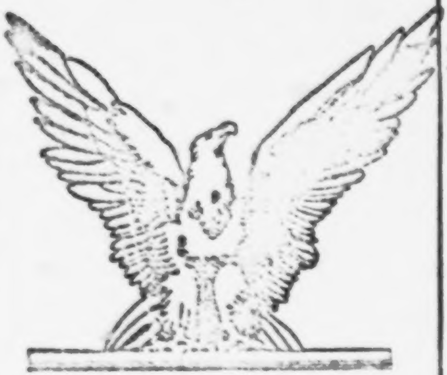

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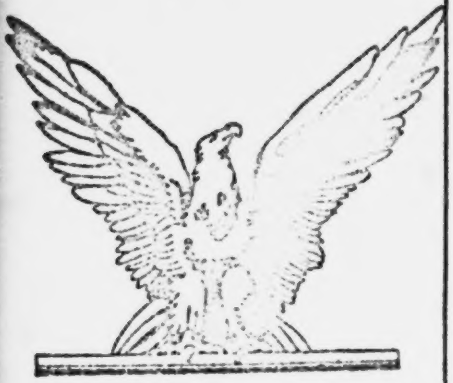

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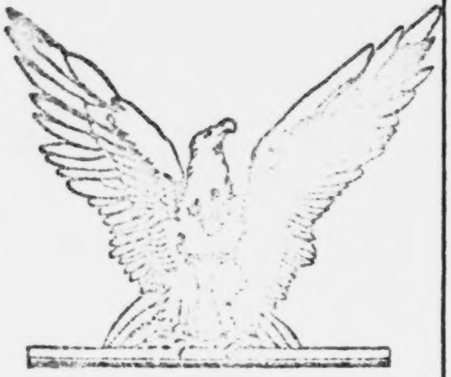

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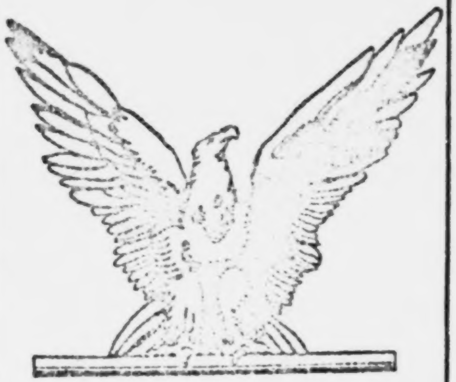

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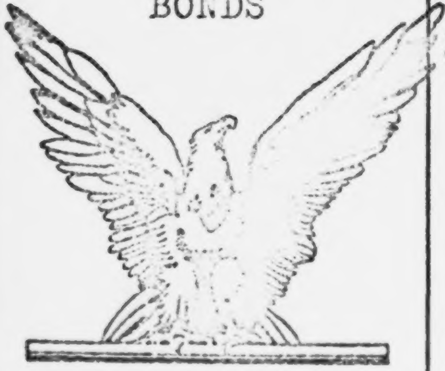

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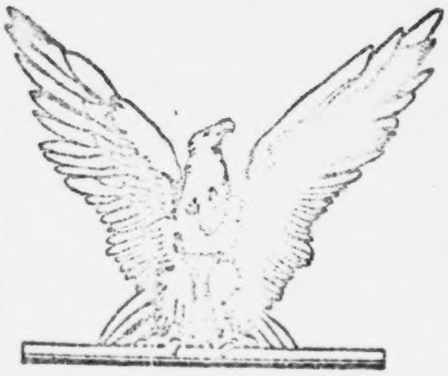

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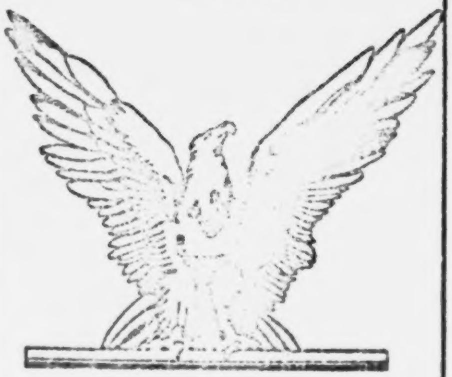

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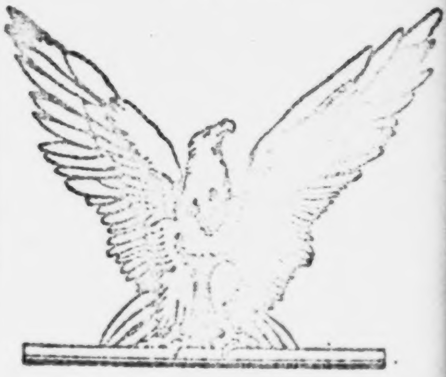

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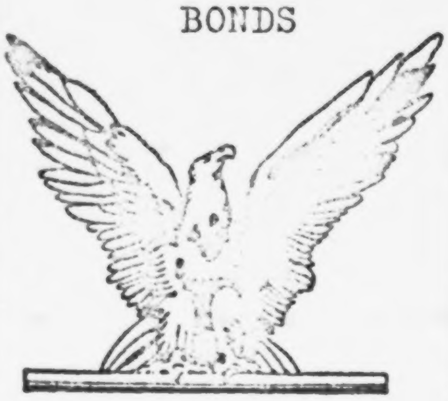

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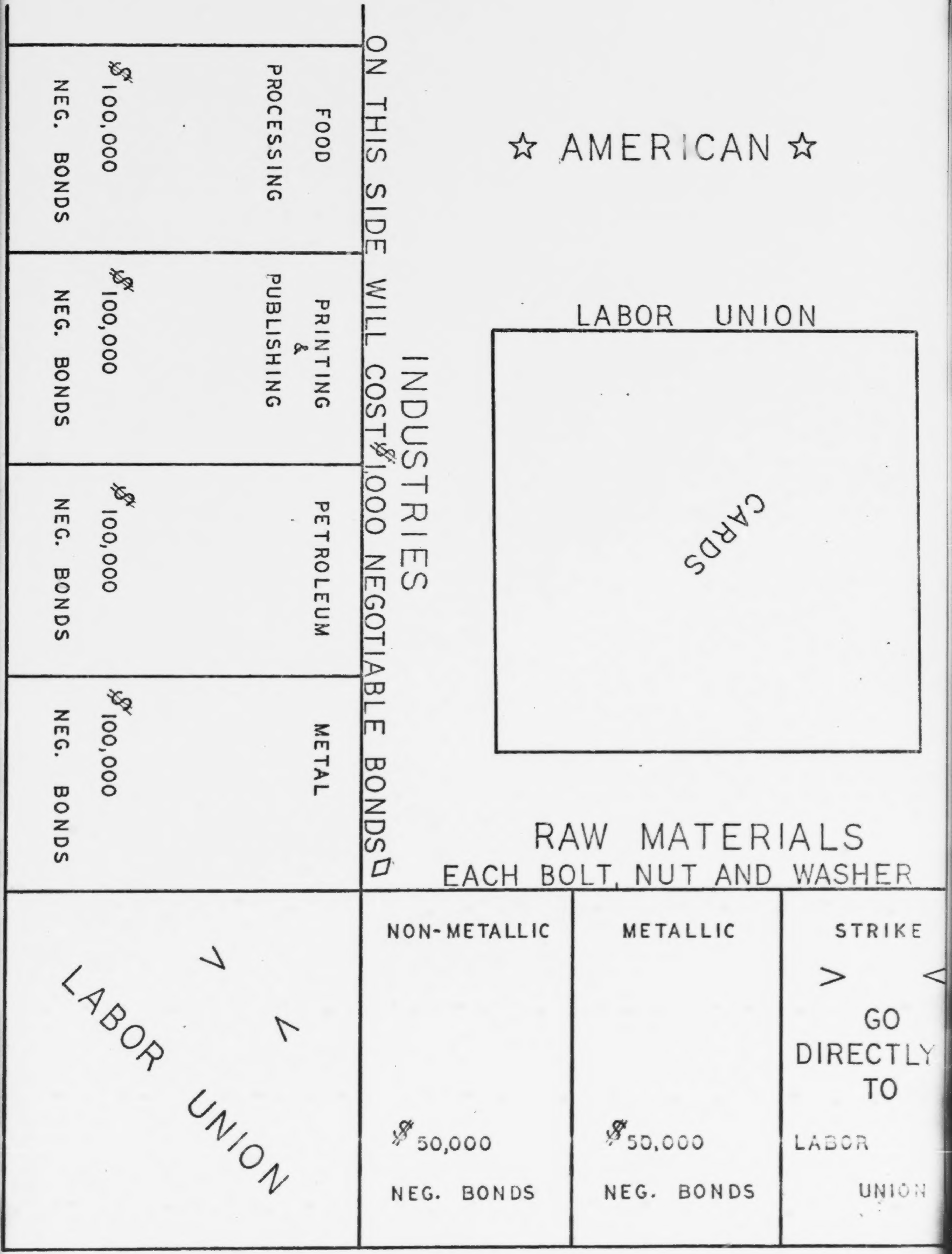
☆ AMERICAN ☆
LABOR UNION
CARDS
INDUSTRIES
ON THIS SIDE WILL COST $1,000 NEGOTIABLE BONDS
FOOD PROCESSING
$100,000
NEG. BONDS
PRINTING & PUBLISHING
$100,000
NEG. BONDS
PETROLEUM
$100,000
NEG. BONDS
METAL
$100,000
NEG. BONDS
RAW MATERIALS
EACH BOLT, NUT AND WASHER
LABOR UNION
NON-METALLIC
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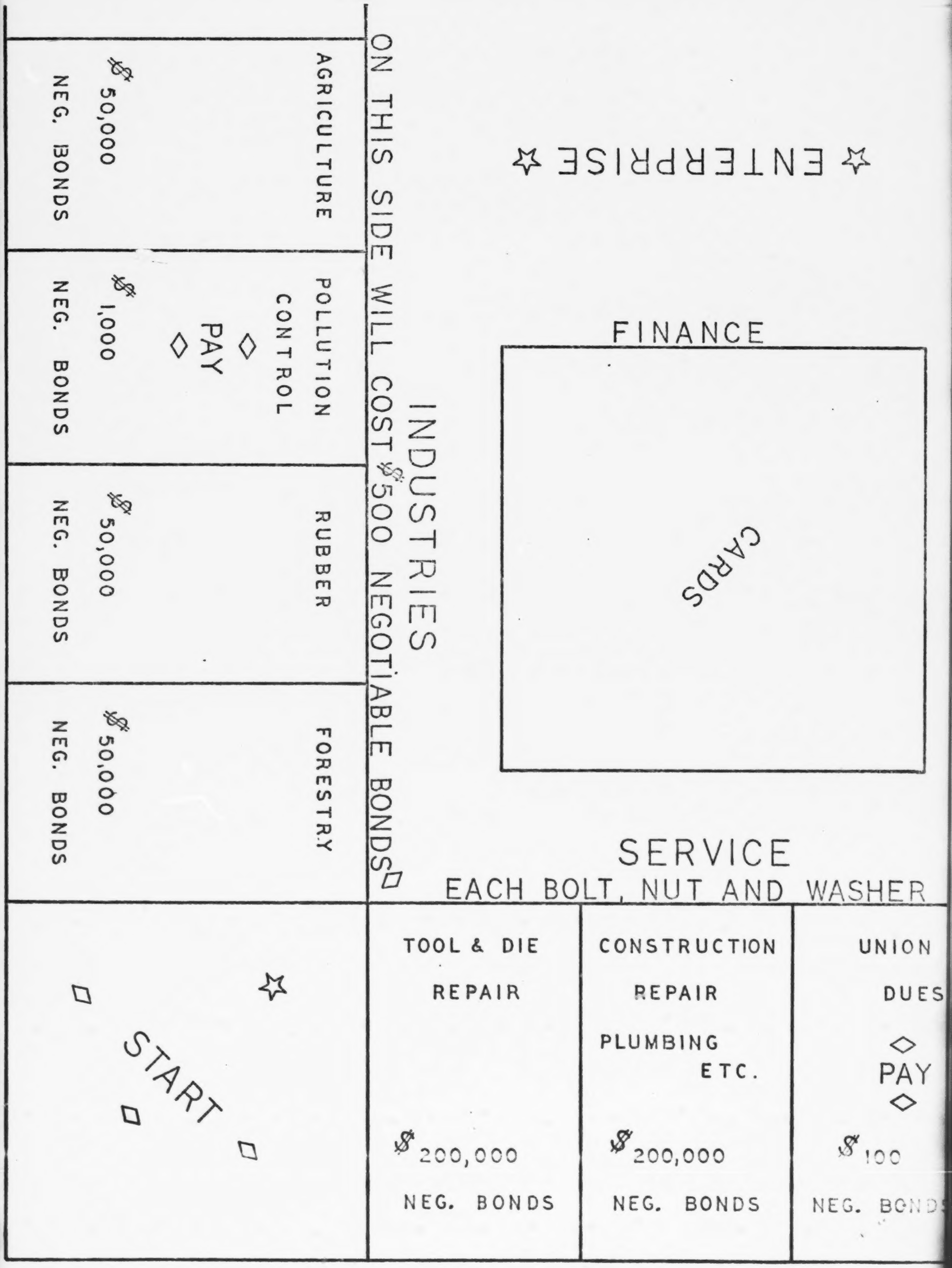
NEG. BONDS
STRIKE
GO DIRECTLY TO
LABOR UNION


ENTERPRISE
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SERVICE
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INDUSTRIES
ON THIS SIDE WILL COST $500 NEGOTIABLE BONDS
AGRICULTURE
$50,000
NEG. BONDS
POLLUTION CONTROL
PAY
$1,000
NEG. BONDS
RUBBER
$50,000
NEG. BONDS
FORESTRY
$50,000
NEG. BONDS
START
TOOL & DIE REPAIR
$200,000
NEG. BONDS
CONSTRUCTION REPAIR
PLUMBING ETC.
$200,000
NEG. BONDS
UNION DUES
PAY
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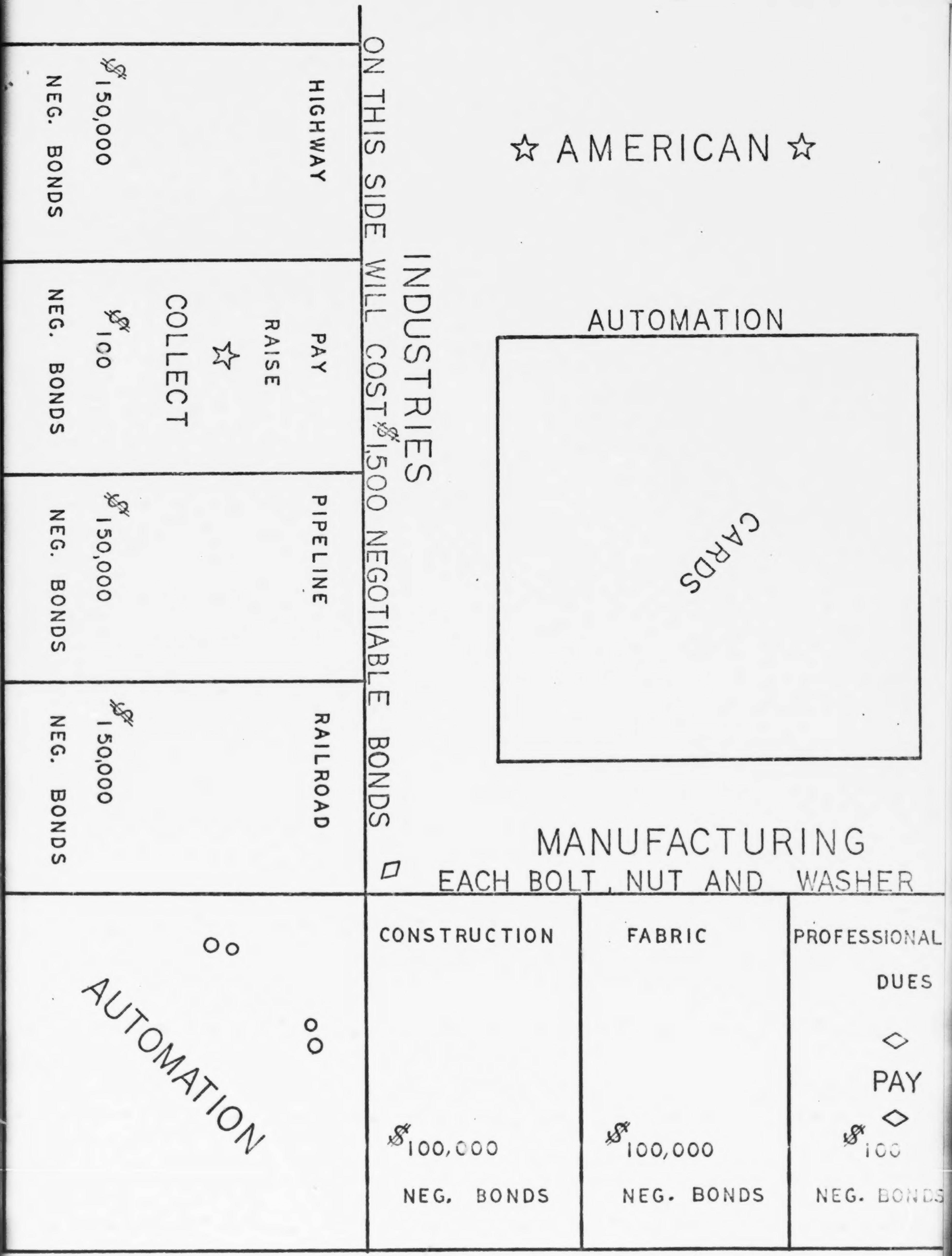
NEG. BONDS


☆ AMERICAN ☆
INDUSTRIES
ON THIS SIDE WILL COST $1500 NEGOTIABLE BONDS
HIGHWAY
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NEG. BONDS
PAY
RAISE
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COLLECT
$100
NEG. BONDS
PIPELINE
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NEG. BONDS
RAILROAD
$150,000
NEG. BONDS
AUTOMATION
CARDS
MANUFACTURING
EACH BOLT, NUT AND WASHER
AUTOMATION
CONSTRUCTION
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PROFESSIONAL
DUES
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PAY
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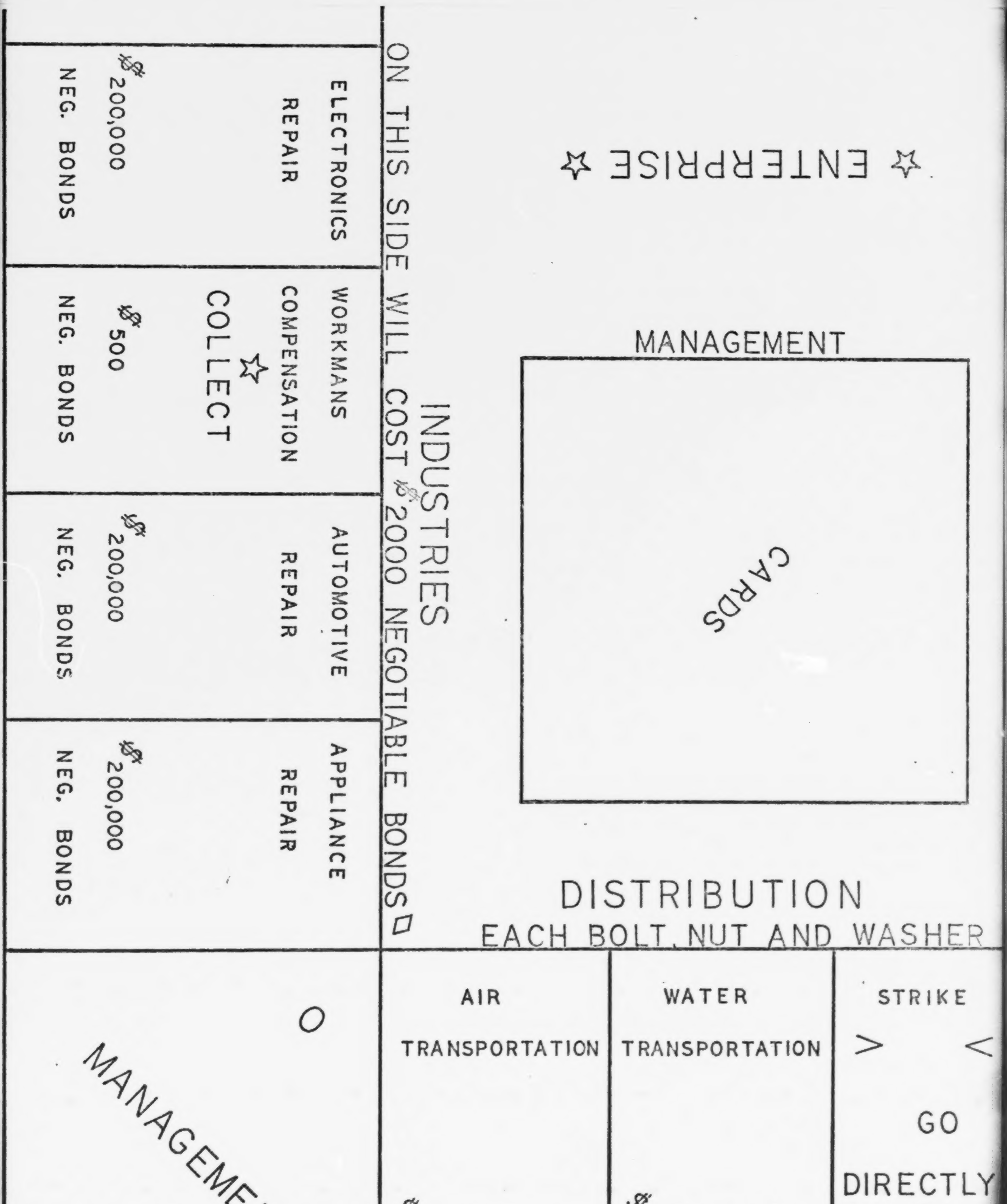☆ ENTERPRISE ☆
MANAGEMENT
CARDS
DISTRIBUTION
EACH BOLT, NUT AND WASHER
INDUSTRIES
ON THIS SIDE WILL COST $2000 NEGOTIABLE BONDS
ELECTRONICS
REPAIR
$200,000
NEG. BONDS
WORKMANS
COMPENSATION
☆
COLLECT
$500
NEG. BONDS
AUTOMOTIVE
REPAIR
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APPLIANCE
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AIR
TRANSPORTATION
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NEG BONDS
WATER
TRANSPORTATION
$150,000
NEG BONDS
STRIKE
GO
DIRECTLY
TO
LABOR UNION

FOR THE STUDENT

THE INDUSTRY

THE USES OF LUMBER IN THE BUILDING TRADES

Objective:

After using this instructional package, you will be able to write at least ten uses for lumber in the building trades.

Activity:

1. Turn to page three and carefully read the directions for the test.
2. Take the test.
3. Count your answers to see if you have ten correct answers.
4. Return your test to the teacher if you have ten correct answers. If you do not have ten correct answers go to step number four. (Note: the teacher may find that you have included several incorrect answers.)
5. Go to the library (classroom, school, or public) and research the following topics, using the dictionary, textbooks, encyclopedias, or pamphlets. Use the topic reference chart (page two) to help you choose which topic or topics to research. (Ask the librarian for help if necessary.)
6. Answer all the questions on the test for the uses of lumber in the building trades.
7. Return your test to the teacher.

TOPIC REFERENCE CHART			
Question #1 Topics	Question #2 Topics	Question #3 Topics	Question #4 Topics
Building Trades	Building Trades	Building Trades	
Construction	Construction	Construction	
Lumber	Lumber	Lumber	Lumber
Wood	Wood	Wood	Wood
Carpentry	Carpentry	Carpentry	
Cabinet Making	Cabinet Making		
Architecture	Architecture	Architecture	Architecture
Masonry	Masonry	Masonry	
House Construction	House Construction	House Construction	House Construction
			Shoring
			Wedge
Woodworking Tools	Woodworking Tools		Woodworking Tools

TEST FOR THE USES OF LUMBER IN THE BUILDING TRADES

Directions:

Print the answers to the following questions in the spaces provided. DO NOT GUESS

1. List six uses for lumber in house construction.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

2. List three uses for lumber in the construction of a school building.

a. ______________________________

b. ______________________________

c. ______________________________

3. List two uses for lumber in the control of concrete.

a. ______________________________

b. ______________________________

(test continued)

4. List two uses for lumber in the construction business which you have not already listed.

   a. ______________________________

   b. ______________________________

TEACHER PACKAGE No. B-31

THE INDUSTRY

ADVANTAGES OF LUMBER IN THE CONSTRUCTION INDUSTRY

Objective:

Given an opportunity to listen to a lecture on the advantages of using lumber in construction and an opportunity to discuss the information presented, the student will demonstrate his new knowledge by writing a list of at least five advantages of using lumber in the construction field.

Activity:

The teacher will need to prepare a thirty minute lecture concerning the advantages of lumber in comparison to other construction materials. Suggested topics are: 1. cost, 2. workability, 3. availability, 4. strength, 5. decay, 6. wear, 7. planning, 8. weight, 9. delivery 10. etc.

Related information could include such local information as: climate problems, building codes, and transportation problems.

Students should be allowed time to ask questions and discuss information. The discussion will aid in the evaluation of the presentation as well as increase the amount of student understanding.

The students should be given a lined piece of paper and then asked to list at least five of the advantages of using lumber in the construction field.

The teacher should evaluate each student's list and return the assignment as quickly as possible for students are anxious to have their paper evaluated and returned.

THE INDUSTRY

CLASSIFICATION FOR CONSTRUCTION LUMBER

Objective:

Given samples of construction grade lumber and an American Lumber Standards Chart, you will mark the grade of lumber which you have been given.

Activity:

1. Get sample pieces of construction lumber from your teacher.
2. Read and study the American Lumber Standards Chart. page 2
3. Select the grade classification which you feel accurately describes each of the lumber samples. (Note: you will need to allow for some flexibility in your grading.)
4. Use a pencil and mark each lumber sample with your grade classification.
5. Ask the teacher to evaluate your lumber grading classifications.

STUDENT INFORMATION SHEET FOR PACKAGE No. B-32

American Lumber Standards Chart

- Total products of a typical log arranged in series according to quality as determined by appearance
  - Finish items (lumber of good appearance and finishing)
    - Suitable for natural finishes
      - Grade A (practically free from defects)
      - Grade B (allows a few small defects)
    - Suitable for paint finishes
      - Grade C (allows a limited number of small defects that can be covered with paint)
      - Grade D (allows any number of defects which do not detract from the appearance of the finish, especially when painted)
  - Boards (lumber containing defects or blemishes which detract from the appearance of the finish but suitable for general-utility and construction purposes
    - Lumber suitable for use without waste
      - Construction-Grade boards (sound and tight knotted stock; size of defects limited; may be considered watertight lumber)
      - Standard-Grade boards (allows large and coarse defects; may be considered graintight lumber)
    - Lumber permitting waste
      - Utility-Grade boards (allows larger and coarser defects than standard-grade and occasional knot holes)
      - Economy-Grade boards (low quality lumber admitting the coarsest defects, such as decay and holes)

FOR THE STUDENT

THE INDUSTRY

LOAD CAPACITY OF LUMBER

Objective:

Given an opportunity to view the overhead transparency entitled, Evaluation of Wood Strength Properties, you will write the answers to the questions concerned with the load capacity of lumber.

Activity:

1. Ask the teacher for permission to use an overhead projector.
2. Turn to page 2, and carefully read the directions for the student worksheet entitled, Test on Wood Load Capacity.
3. View the transparency entitled, Evaluation of Wood Strength Properties, and complete the worksheet.
4. Give your worksheet to the teacher.

STUDENT WORKSHEET

Test on Wood Load Capacity

Directions:

Answer the following questions while you are viewing the overhead transparency entitled, Evaluation of Wood Strength Properties.

1. List three kinds of forces applied to wood while it is being used.

   a. ______________________________

   b. ______________________________

   c. ______________________________

2. Which grain direction (parallel or perpendicular) will support the most weight?

   ____

3. From the information presented on the transparency write a statement telling why the trademark on a baseball bat is located where it is.

4. Which grain direction (parallel or perpendicular) will be the most flexible?

   ____

5. Write a statement concerning the importance of wood strength properties in the various structural applications. 25 words or less

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. B-33

A set of overhead transparencies entitled, Wood Technology Transparencies, is available from:

DCA Educational Products, Inc.
4865 Stenton Avenue
Philadelphia, Pa. 19144

Phone: 215-GL-7-0400

The transparency suggested in Package B-33, (Evaluation of Wood Strength Properties), can be purchased as a separate unit or the complete set on wood technology can be purchased. The complete set includes twenty transparencies concerned with wood technology.

Approximate Cost: $60. per set

TEACHER PACKAGE

THE INDUSTRY

JOB OPPORTUNITIES IN THE CONSTRUCTION FIELDS

Objective:

Given an opportunity to listen to a guest speaker and discuss with him the various vocational choices available in the construction field, the student will write a short report on one vocational choice in the construction field.

Activity:

The teacher will need to make the necessary arrangements to invite a resource person to speak to the class. The teacher can choose from various agencies such as: labor unions, industrial commissions, guidance counselors, vocational counselors, private contractors, etc. It is important that the resource person fully understands all the requirements which this class presentation and the discussion will demand.

It is suggested that the initial contact be made in person or by telephone. Having received an acceptance, the teacher may wish to follow the suggested procedure for using a resource person. (page 2)

The teacher should send the speaker a copy of this package, (B-39, Job Opportunities in the Construction Fields), to aid him in planning his presentation.

Following the speaker's presentation the teacher should allow students to ask questions of both the speaker and himself.

The students should be given a specific length of time to write their paragraph either in class or as a homework assignment.

The teacher must evaluate this assignment in terms of each student's new knowledge concerning vocational choices in the construction field. Also remember, each student will be anxious to have his assignment evaluated and returned.

SUGGESTIONS FOR EFFECTIVE USE OF RESOURCE PERSONS

After the initial contact has been made:

1. Obtain background information about the resource person in order to present him to the class.
2. Send the speaker a copy of package number B-39, Job Opportunities in the Construction Fields.
3. Provide information to the speaker describing the type and number of students, the program, facilities and equipment you can provide, etc.
4. Request the speaker to encourage students to continue their education and training to the limit possible.
5. Ask the speaker to cover such things as:
    - a. job opportunities
    - b. types of occupations in the construction field
    - c. job requirements
    - d. nature of the work
    - e. employee benefits (salary, fringe benefits, etc.)
    - f. training and education needed for this type of work
    - g. how and where training can be obtained
    - h. what satisfactions workers receive from this type of work
6. Indicate to the speaker that the maximum speaking time should be held to 30 minutes so that there will be time for student questions.

Hints to teachers:

1. Prior to the speaker's visit, orient students to the field to be discussed.
2. Provide follow-up with students the next day and thereafter.

FOR THE STUDENT

No. B-40

THE INDUSTRY

OTHER INDUSTRIES RELATED TO LUMBER

Objective:

Given an opportunity to review packages B-41 - B-46, you will select one package which studies an industry related to lumbering.

Prerequisite:

You will need to have packages B-41 - B-46 available.

Activity:

1. Read the student information sheet. (page 2)
2. Ask the teacher for packages B-41 - B-46.
3. Read each package carefully.
4. Select one package which interests you. (Note: Be sure you understand the activities outlined in the packages.)
5. Return the remainder of the packages to the teacher.
6. Start the activities for the package which you have selected.

STUDENT INFORMATION SHEET No. B-40

There are many industries which use wood as their basic natural resource. Students having special interest in the woodworking field may find that studying one of these industries will provide information helpful in planning his future. Packages B-41 through B-46 provide a means for studying several industries related to wood or wood products.

FOR THE STUDENT

THE INDUSTRY

THE MAKING OF PAPER

Objective:

Given an opportunity to use the library (shop, school or public), you will research the word paper and write a two page report limited to the making of paper.

Activity:

1. Go to the library (shop, school, public).
2. Use two of the suggested sources of information.
   Note: Ask the librarian for help if necessary.
   - a. Encyclopedias
   - b. Pamphlets
   - c. Textbooks
   - d. Periodicals (Monthly Magazines)
3. Write a two page report using the information found by your research.
4. Ask the teacher to evaluate your report.

FOR THE STUDENT

No. B-42

THE INDUSTRY

THE FURNITURE INDUSTRY

Objective:

Given an opportunity to interview a furniture store manager or an executive from a furniture manufacturing company, you will write a list of ten factors which are important to the furniture making industry.

Activity:

1. Ask the teacher for a list of local stores or companies in the furniture business.

2. Select a store or company which you feel will provide the best information concerned with the making of furniture.

3. Write a list of twenty questions which can be used for the interview. (Note: the questions will very somewhat depending on the person to be interviewed.)

4. Ask the teacher to edit your questions.

5. Rewrite the questions.

6. Contact the store or company by telephone and arrange a personal interview with a person knowledgeable in the furniture making business. (Note: Be sure that you are not interviewing a person whose responsibility is limited to the selling of furniture.

7. Conduct the interview using your questions and others which arise during the interview. If possible use a portable tape recorder to record the interview.

8. Write a list of ten factors for the making of furniture which were stated during the interview.

9. Ask your teacher to evaluate your list of factors.

10. Prepare and mail a letter of thank you to the person interviewed.

FOR THE STUDENT No. B-43

THE INDUSTRY

BY-PRODUCTS OF WOOD

Objective:

Given information and materials concerned with the by-products of wood, you will prepare a ten minute class presentation describing five by-products of wood.

Activity:

1. Design and write a letter requesting information and materials concerned with the by-products of wood. This letter can be sent to:

   Forest Products Laboratory
   Madison, Wisconsin

2. Ask your teacher to edit the letter.
3. Rewrite your letter making any corrections suggested by your teacher.
4. Mail the letter.
5. Select five by-products which interest you from the materials received.
6. Research the materials pertaining to the by-products you selected.
7. Write a one page report on each of the selected by-products.
8. Ask your teacher to evaluate your reports before presenting them to the class.
9. Become as informed on each of the selected by-products as you can before making your presentation.
10. Ask your teacher to allow ten minutes in the near future for your presentation.
11. Give your presentation to the class.

Suggestions

a. Place information on the bulletin boards.
b. Don't read your reports to the class if possible.
c. Try to make your presentation at the beginning of a class period.
d. Keep the presentation limited to ten minutes.
e. Allow fellow students to ask questions.

FOR THE STUDENT

No. B-46

THE INDUSTRY

THE MAKING OF PARTICLE BOARD

Objective:

Given an opportunity to view the overhead transparencies entitled "Particle Board" and "The Manufacture of Particle Board", you will write the answers to the questions concerning particle board.

Activity:

1. Ask the teacher for permission to use an overhead projector.
2. Turn to page 2 and carefully read the directions for the student worksheet entitled "Worksheet on Particle Board".
3. View the transparencies entitled "Particle Board and "The Manufacture of Particle Board".
4. Answer the questions provided on the student worksheet.
5. Give your student worksheet to the teacher.

WORKSHEET ON PARTICLE BOARD

No. B-46

Directions:

Answer the following questions while you are viewing the overhead transparencies entitled "Particle Board" and "The Manufacture of Particle Board".

1. Name the two most important materials used in making particle board.

____

____

2. Name three physical properties which are unique to particle board.

____

____

____

3. Name the two basic types of particle board which are available.

____

____

4. List the manufacturing steps which are necessary to produce particle board.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B-46

A set of overhead transparencies entitled "Wood Technology Transparencies" are available from:

DCA Educational Products Inc.
4365 Stenton Avenue
Philadelphia, Pa. 19144
Phone 215-GL-7-0400

The transparencies suggested in package B-46, The Making of Particle Board, can be purchased as separate units or the complete set on wood technology can be purchased. The complete set includes twenty transparencies concerned with wood technology.

Approximate cost per set: $60.00

FOR THE STUDENT

THE INDUSTRY

THE STORY OF IRON AND STEEL

Objective:

After studying this instructional unit you will list 5 operations necessary to convert the raw materials into a usable steel product.

Activity:

1. Nine out of every ten pounds of metals used in the world are steel. Are you able to list at least 5 operations necessary to convert the raw materials into a usable product?

   1. ________________________________
   2. ________________________________
   3. ________________________________
   4. ________________________________
   5. ________________________________

2. If you were able to answer the above question, fill in the blanks below and return this paper to your instructor.

3. If you cannot answer these questions, study the film strip "How Steel is Made" and fill in the questions below as you go along. You may use the Flow Chart for extra help.

   1. The three most important raw materials used in making steel are ______________, ______________, ______________.
   2. Iron ore is mined in large open pits. It is transported to the steel mills by ______________ and then by ______________.
   3. Coal is used in the steel mills to make ______________.
   4. The first step in making steel is to convert the raw material into molten iron. This is done in a ______________ furnace.
   5. The most important furnaces used for refining iron and scrap into steel are ______________, ______________, ______________.

6. Molten steel is poured into large ingot molds. These ingots are reheated and then changed into Blooms, Billets, or slabs by large ________________.
7. Blooms are generally rolled into ____________________.
8. Billets are rolled into _________________________.
9. Slabs are rolled into ___________________________.

Post test:

Go back and answer the question in Step 1 before returning this paper for checking.

Extra Credit: Look around this class room. How many things can you name that are made of steel?

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. B50

A 55-frame color filmstrip, 61-page teacher's guide, with filmstrip text, and notebook Flow Charts - "How Steel is Made" are available free of charge; if your request is made on school stationery to:

Director-Educational Services
Public Relations
U. S. Steel Corporation
525 William Penn Place
Pittsburg, Pennsylvania 15230

The filmstrip and flow chart are all that is needed for a student to complete this package. For added information, a narration to go along with the filmstrip may be placed on a tape. The teacher's guide is written in such a way that it may be used for this purpose.

This package may also be used as a teacher package by using the student's sheets as a handout, and showing the filmstrip to the entire class using you, the teacher, as the narrator from the teacher's guide.

FOR THE STUDENT No. B59

THE INDUSTRY

CAREER OPPORTUNITIES IN IRON AND STEEL

Objective:

You will list an occupational opportunity the Iron and Steel Industry offers to men and/or women that you want to learn more about.

Activity:

1. Read pages 27 through 31 in "The World of Steel".
2. Read pages 55 and 56 in "The Picture Story of Steel".
3. Answer the following questions.
    1. What percent of jobs in the modern steel industry are classed as skilled or semi-skilled?

       ____.

    2. How are many of the skilled steelworkers trained?

       ____

       ____.

    3. How does the steel industry compare in safety with other industries?

       ____

       ____

Post test:

List an occupation or occupations that you want to learn more about.

____

____

TEACHER'S REFERENCE FOR THE [illegible] STUDENT MESSAGE No. 159

"The World of Steel" is available from the U.S. Steel Corporation (See Message 150, Teacher's Reference for address).

"The Picture Story of Steel" is available from:

Republic Steel Corporation
Market Development Division
1424 Republic Building
Cleveland, Ohio 44101

Or, the Republic Steel sales office in your area.

THE INDUSTRY

THE STORY OF ALUMINUM

Objective:

Given a list of events in the history of aluminum, you will arrange them in the proper order.

Activity:

1. Read all the information under activity before doing part 2.

2. View the film "Unfinished Rainbows" if it is available. Study the booklet "Charles Martin Hall, Father of The Aluminum Industry".

3. Under line the correct word or words in the following paragraphs as you view the film.

    a. Chemical processes used to free aluminum from the ore were very (costly, cheap).

    b. The production cost of aluminum was about \$545 per pound in 1852. The cost decreased to about \$17 per pound by 1859. After the development of the Hall Process in 1886, cost was greatly (increased, reduced).

    c. After Hall developed his process of extracting aluminum from bauxite, his next big step was to sell the public on the use of aluminum. This task was (easy, hard).

    d. The first products to be cast from aluminum were for the (house, car). Other products that were eventually made were wire, furniture, and railroad cars.

Post Test:

Place the numbers, 1,2,3,4 and 5 before the statements below to show their order of events in the history of aluminum.

___ The aluminum tea kettle.

___ Chemical process of making aluminum.

___ Fabricating aluminum by almost every metal working process.

___ Hall's process of making aluminum.

___ The first aluminum ingot was poured.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B70

If film "Unfinished Rainbows" is not in your local film library it is available from:

Association Film, Inc.
512 Burlington Ave.,
LaGrange, Illinois 60525

The booklet, "Charles Martin Hall, Father of the Aluminum Industry", (# A02-20269), is available from:

Aluminum Company of America
1501 Alcoa Building
Pittsburgh, Pa. 15219

FOR THE STUDENT

No. B71

THE INDUSTRY

SOURCES OF ALUMINUM

Objective:

You will be able to name the ore from which aluminum is made and also list an area or areas that this ore may be located.

Activity:

1. Read all the information under activity before doing part 2.
2. Listen to the tape "Sources of Aluminum".
3. Answer the following statements (T) true or (F) false as you listen to the tape. Place an X on your answer.
    1. T F Aluminum was called "the metal of clay" because small pieces of aluminum could be found in the clay taken from the river banks.
    2. T F Aluminum is one of the most abundant metals.
    3. T F Aluminum compounds make up about 15 per cent of the earth's crust.
    4. T F Alabama and Georgia furnish most of the bauxite ore that is mined in the United States.

Post Test:

1. Aluminum compound is chemically known as alumina. If an ore contains more than 32% alumina it is considered ____________________.
2. ____________________ furnishes 98% of the bauxite mined in the United States.
3. Other sources of bauxite are ____________________ ____.

Text of tape:

Although its discovery as a metal did not come until some 7,000 years later, aluminum nevertheless was one of the first earth materials put to use by man. About 5300 B.C. in Northern Iraq, the art of pottery making was developed. The clay used for making the best pottery consisted largely of a hydrated silicate of aluminum.

Primitive man took clay (perhaps exposed on river banks), mixed it with water, and beat it into thin sheets on a flat rock, or the ground. The sheets could then be formed into the shape of vessels and placed in the sun or beside a fire to dry. Once dry, the clay became "as hard as stone," and could be used for carrying water or for cooking.

Thus the pottery makers, in using aluminous clays to form cooking utensils, foreshadowed by thousands of years one of the earliest uses of the metal itself.

Certain other aluminum compounds such as the "alums" were in widespread use by the Egyptians and Babylonians as early as 2000 B.C. in vegetable dyes, in various chemical processes and for medicinal purposes.

Despite this early beginning, after nearly 7,000 years of use, all the skills of man had not succeeded in separating "the metal of clay" (as it was called) from its age-old bondage to the other elements of the earth. It could not be separated by chemicals or with quicksilver, nor beaten out with hammers, nor driven forth by fire, as could be done with most other known metals.

Today, aluminum is one of the most abundant metals, but it is never found in the earth as a pure metal. Miners can dig copper and gold, but nobody has ever dug a piece of aluminum. It exists in its natural state only chemically combined with oxygen, silicon, and other elements. Aluminum compounds make up more than 15 per cent of the earth's crust. All soils and many rocks and minerals contain aluminum compounds.

Aluminum can be made inexpensively only from an ore called bauxite. Bauxite usually occurs in a hard, rock-like formation. But it may also be as soft as mud.

Most of the aluminum used in the United States and Canada comes from bauxite ore mined in Jamaica and Surinam. Arkansas furnishes about 98 per cent of the bauxite that is mined in the United States. The rest of the bauxite mined in the United States comes from Alabama and Georgia. The major bauxite producing areas outside the United States include France, Greece, Guinea, Guyana, Hungary, Jamaica, Russia, Surinam, and Yugoslavia.

To be considered bauxite, the ore must contain more than 32% alumina (aluminum oxide) that can be recovered. Most aluminum comes from bauxite that contains from 45 to 55 percent alumina.

... Now let us check your answers to the true and false statements. Statement A is false... Remember - Aluminum is never found in the earth as a pure metal. It is always found in a compound called "alumina" or "bauxite". Statements B and C are true. Aluminum ranks third in the order of abundance of elements in the earth's crust. Oxygen is first, followed by silicon and then alumina. Statement D is false. Arkansas furnishes about 98 per cent of the bauxite mined in the United States.

FOR THE STUDENT

THE INDUSTRY

HOW ALUMINUM IS MADE

Objective:

Given a list of the operations to make aluminum, you will list them in their proper sequence.

Activity:

1. Read pages 12 thru 15 in the booklet "The Story of Aluminum".

2. Answer the following questions by underlining the proper word or words to complete the statements.

   a. Water is (added, removed) from the ore in the rotary kilns after it has been ground up into a uniform partical size.

   b. (Baking Soda, Caustic Soda) is added to the ground ore to dissolve the alumina and form sodium aluminate. This takes place in the thickener tanks where the mixture is allowed to stand.

   c. The "Green Liquor" is drained off and transferred to precipitator towers. Here alumina crystals are added and form groups that become physically heavy enough to (settle, float). These new aluminum hydrate crystals are then washed, dried, and roasted in inclined tubes.

   d. The refining processes completed, the alumina smelting in the reduction furnace is completed by (coal heat, electricity).

   e. The molten metal is tapped from the (side, bottom) of the pot or siphoned off into giant crucibles. The molten metal is now ready for casting or further alloying before casting.

Post Test:

1. Place the numbers 1,2,3,4 and 5 in front of the operations listed below so you have them arranged in the proper order to produce aluminum.

_______ Rotary Kiln

_______ Reduction Pots

_______ Add Caustic Soda

_______ Precipator Towers

_______ Thickener Tanks

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B72

The booklet "The Story of Aluminum" is available from:

Aluminum Company of America
1501 Alcoa Building
Pittsburgh, Pa.. 15219

When ordering specify # A oz-11952. Other materials and wall charts showing the refining and smelting operations are available.

Answers to questions in activity:

1. Removed
2. Caustic soda
3. Settle
4. Electricity
5. Side

Answers to post test:

1 Rotary Kiln

5 Reduction pots

2 Add caustic soda

4 Precipator towers

3 Thickener tanks

FOR THE STUDENT

No. B75

THE INDUSTRY

ADVANTAGES OF USING ALUMINUM

Objective:

Given a list of the advantages of aluminum, you will list the advantages that meet the requirements for the product.

Activity:

1. Check out a copy of "The Story of Aluminum" from your instructor or your librarian.
2. Read page 18.
3. Complete the post test using this list of advantages before returning all materials to your instructor.

I. Aluminum weighs only about one-third as much as copper or steel.

II. Aluminum is strong in alloy form.

III. Aluminum is highly resistant to corrosion.

IV. Aluminum is an excellent conductor of electricity.

V. Aluminum conducts heat rapidly.

VI. Aluminum has a high reflectance for both light and radiant heat.

VII. Aluminum can be safely used with foods and medicine.

IX. Aluminum can be given a wider variety of finishes than any other metal.

X. Aluminum does not readily absorb neutrons.

XI. Aluminum can be formed by all known metal-working processes.

Post Test:

From the list under activities record the numbers of the advantages in using aluminum to make:

Electric frypan ______________________________

____

Boat ____

____

Siding for a house ___________________________

____

(____________________) ______________________
Product of your choice.

____

____

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B75

The booklet "The Story of Aluminum" is available from:

Aluminum Company of America
1501 Alcoa Building
Pittsburgh, Pa. 15219

When ordering specify # E 02-11952.

FOR THE STUDENT

THE INDUSTRY

INGREDIENTS OF IRON AND STEEL

Objective:

After studying this instructional unit, you will list the raw materials for making iron and steel, and trace their path from their source to the blast furnace.

Prerequisite:

The completion of Unit No. 50 would be very helpful before starting this unit.

Activity:

If you have difficulty in answering any of these questions, check out a book or books on iron from your instructor or your librarian. The World Book Encyclopedia is also a very good place to look for additional information.

Fill in the blank spaces of the diagram on your worksheet (page 2).

Answer questions 1 through 7 on your worksheet (page 2).

Post test:

Recheck your answers that you placed on the diagram. Circle any incorrect answers and then add the correct ones.

STUDENT WORKSHEET

No. B51
Insert # 1

____
From - Great Lakes Area
Transported by ____________________

Coal
From______________________________
Transported by______________________ ________

IRON AND STEEL
MILLS

____
From______________________________
Transported by Rail

Fill in the blank spaces above and then answer the Questions below.

1. The three most important raw materials used in making iron are________________________________,
________________ ___and ____________________.

2. The largest open pit ore mine in the World is on the Mesabi Range in ____________________.

3. Some iron ore beds are too far down in the earth for open pit mining. These are mined by________________
____.

4. Iron ore is generally transported from the mines to the mills by____________________and____________________.

5. Iron ore which contains relatively small amounts of iron is called ____________________. This ore is concentrated and then formed into pellets to be transported to the mills.

6. Coking coal is found in the eastern half of the United States. It is mined deep in the ground and then transported to the mills where it is heated in tall, narrow coking ovens to make________. Gases from these ovens are recovered to produce by products such as:
a.____________________ b.____________________
c.____________________

7. The method of mining____________________is very much like the mining of iron ore. The open pits are called quarries and are found in many parts of the United States.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO.B51

A 32 page book "The World of Steel" is available from the U.S. Steel Corporation (see B50, Teacher's Reference).

Answers to diagram:

Iron ore--Great Lakes Area--Rail and Boat
Coal--Eastern Half of United States--Rail
Limestone--Many parts of United States--Rail

Answers to Questions 1 through 7:

1. Iron ore, limestone, and coal.
2. Minnesota
3. Under ground mining methods.
4. Railroad cars and ore boats.
5. Taconite
6. Coke, nylon, synthetic rubber, plastics, benzene, toluene, and many others.
7. Limestone

No. B52

FOR THE STUDENT

THE INDUSTRY

THE BLAST FURNACE

Objective:

The student will, in his own words, give a written description of the loading, operation, and tapping of a Blast Furnace.

Prerequisite:

The completion of Units B50 and B51 would be helpful, but not required, to complete this unit.

Activity:

Check out a copy of "The World of Steel" from your instructor or your class library.

Review Chapters 1 and 2.

Read Chapter 3.

If the film is available, view "Steel of the Rouge".

Answer the following questions and the post test in the spaces provided. Turn in the papers to your instructor when you are through.

1. Why doesn't the great heat inside iron and steel making furnaces melt the walls of the furnaces?

   ____

2. What is the name of the furnace that changes iron ore into iron? Why was it given that name?

   ____

   ____

3. How is the furnace loaded with raw materials?

   ____

4. How would you describe what happens inside the furnace?

____

____

5. In making a ton of iron, which is heavier, the total weight of the raw materials, or the total weight of the air used?

____

____

6. How many days would it take an ancient furnace to make as much iron as a modern furnace makes in 24 hours?

____

____

Post Test:

State in your own words, the operation of a blast furnace from the loading of the raw materials to tapping.

____

____

____

____

____

FOR THE STUDENT No. B53

THE INDUSTRY

METHODS OF MAKING STEEL

Objective:

The student will list three furnaces used in the conversion of iron to steel.

Activity:

Read Chapter 4 in "The World of Steel".

Answer the following questions. Return to your instructor when you are through.

1. How is iron from the blast furnace changed into steel?______________________________

____

2. What are the three kinds of steelmaking furnaces? Describe how each one makes steel.

____

____

____

____

____

____

3. How does the use of scrap steel help conserve our natural resources?__________________________

____

____

Post Test:

List three furnaces used in the conversion of iron to steel. See if you can list them in the order of their production, the most productive first.

____

____

____

____

THE INDUSTRY

THE ROLLING MILLS

Objective:

The student will list the processes needed to convert molten steel into a shape that is usable by the manufacturer.

Prerequisite:

The completion of Units B50 thru B53 would be helpful, but not required, to complete this unit.

Activity:

1. If available, view the film "Steel on the Rouge".
2. Read Chapter 5 in "The World of Steel".
3. Answer the following questions using the word or words from the list provided. You may use the words more than one time.
    1. Hot molten metal is poured from the ladle into a hollow metal form called ________________.
    2. After the liquid steel cools enough to become solid, the iron mold is removed, leaving a red-hot block of steel called________________.
    3. Before rolling, ingots are reheated until they are white-hot in a ________________.
    4. An ingot is rolled into one of three principle shapes called________________, ________________, or________________.
    5. In place of rolling ingots, the metal may also be shaped by a new process called________________-________________.
    6. Rails and beams are rolled from________________.
    7. Flat steel is rolled from________________.

8. Rods, bars, wire, and pipe are rolled from ______________________________.

Words to be used to answer the questions:

An ingot

Billets

Blooms

Continuous casting

Ingot molds

Slabs

Soaking pit

Post Test:

List the processes used to prepare steel to be used in the fender of an automobile. Use the back side of this sheet if you need more room.

THE INDUSTRY

THE STORY OF COPPER

Objective:

You will complete a block diagram showing the steps involved in obtaining copper from the ore.

Activity:

1. Research the story of copper by looking up copper in an encyclopedia or a textbook on metals.

2. Fill in the missing word or words in the following statements.

   a. Copper ore is ____________by large power shovels and placed in railroad cars. At the mills, the cars dump the ore into powerful crushing machines that break the ore into pieces less than 9inches in diameter.

   b. The ________________ processes a soup-like mixture of copper ore called slurry.

   c. Flotation cells ________________ the copper from the ball mill. Chemicals bring the copper minerals to the top to be scrapped off and dried.

   d. The ____________________ shoots flames above the copper material. Impurities rise to the top and form a slag that is drained off.

   e. The ___________________ finally reduces the original ore to metalic copper. This blister copper is more than 97 per cent pure.

   f. ___________________________ produces 99.9 per cent pure copper.

Post test:

In the blocks provided, name the steps involved from the ore to 99.9 percent pure copper.

99.9 percent pure copper

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B60

Answers to part two of Activity:

a. Mined
b. Ball mill
c. Concentrate
d. Reverberatory furnace
e. Converter
f. Electrolytic refinning

Answers to the Post test:

Mining
The Ball Mill
Flotation Cell

Electrolytic Refinning
The Converter
Reverberatory Furnace

99.9 percent pure copper

FOR THE STUDENT No. B61

THE INDUSTRY

WORKING WITH COPPER

Objective:

Given a list of production methods for working with copper, you will name products made by these methods.

Activity:

View the film, "Creative Coppermetals". The film shows many brass (a copper alloy) mill manufacturing operations. The film starts in a casting shop and follows the progress of the metal through the many operations required to change its size and form.

Post test:

Using the list below, name a product that you think was made by that production method.

Casting ______________________________

Hot rolling ______________________________

Cold rolling ______________________________

Slitting ______________________________

Drawing ______________________________

Extrusion ______________________________

Piercing ______________________________

Machining ______________________________

"Creative Coppermetals" is available without charge to schools. Requests for the use of this film should be made as far in advance of showing date as possible.

Write to:

Anaconda American Brass Company
Sales Promotion Department
414 Meadow Street
Waterbury, Connecticut 06720

or your local Anaconda American Brass Company Dealer.

THE INDUSTRY

HOW ALUMINUM IS SHAPED

Objective:

Given a list of aluminum products, match the products with the method used to shape the product.

Activity:

As it is freshly created by the primary aluminum producers, the metal is a lustrous, silvery liquid. It has no shape of its own, any more than water has, except that of the container in which it happens to be at the moment.

Let us consider some of these shapes and how they effect us in everyday life. The first shape that molten aluminum takes after leaving the holding furnace is the ingot. Ingots may vary in size and shape but the most common are the rolling ingot, the alloy ingot, and the billet. The products produced from these ingots are described in the booklets "A Brief Story of Aluminum and Alcoa" pages 7 thru 14 and "The Story of Aluminum", pages 20 thru 27. After studying either or both booklets, try the post test. If you do not make 100% on the post test, reread the booklets.

Post Test:

Match the product to the method of manufacture by placing the letter from the right column in the proper blank.

_____	connecting rod	A. casting
_____	storm door frame	B. extruding
_____	Aluminum foil	C. cold rolled
_____	milk bottle cap	D. rolled to less than .006 in.
_____	automobile transmission case	E. drawing
_____	rods and bars	F. forging
_____	wire	G. impact extrusion
_____	rivets	H. powder and paste
_____	paint	I. fasteners
_____	toothpaste tube	J. closures

Reading from bottom to top, your answers should be G,H,I,E,C,A,J,D,B,F.

Make a list of products and the method you think was used to produce each one. Return all papers to your instructor.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B73

The following literature is available from Alcoa (see B70 for address).

*	Fabricating Alcoa Aluminum Chart	A02-10850
*	A Brief Story of Aluminum and Alcoa	A02-11889
*	The Story of Aluminum	A02-11952
#	Alcoa Aluminum Complete Extrusion Capability	A01-12096
#	Alcoa Impacts, Metal in Motion	F09-10551
#	Alcoa Forgings	F08-11184

* Used in this package.

Very helpful in presenting this package.

FOR THE STUDENT

No. B74

THE INDUSTRY

FINISHES AND COATINGS FOR ALUMINUM

Objective:

Given a list of finishes and coatings of aluminum, you will prepare a report on one finish to present to the class (5 to 10 minutes in length).

Activity:

Aluminum can be given surface finishes to challenge any service condition. Finishes help to maintain the beauty of the original design through years of exposure. Some of the many methods and finishes are:

Mechanical: grinding, polishing, and buffing.

Electrochemical: color finishes, hard coating, and electrobrightening.

Electroplated: Silver, brass, and chromium.

Applied coatings: paint, plastic, and metalic coatings.

These and other finishes are explained in the folder, "The Many Faces of Aluminum". Check out a copy from your instructor or librarian for additional information.

Post Test:

Select one of the finishes used on aluminum and write a short report (5 to 10 minutes) to be presented to the class. Have the report checked by your instructor before you make your presentation. You may use photos, samples, or other aids to help you.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B74

The booklet "The Many Faces of Aluminum" is available from:

Aluminum Company of America
1501 Alcoa Building
Pittsburgh, Pa. 15219

When ordering specify # E02- 12175C

FOR THE STUDENT

No. B79

THE INDUSTRY

CAREERS IN THE ALUMINUM INDUSTRY

Objective:

You will list an occupational opportunity the aluminum industry offers to men and or women that you want to learn more about.

Activity:

1. Check out a copy of "The Story of Aluminum" from your instructor or librarian and read pages 29 through 31.
2. Make a list of four or more occupations and specify the educational requirements, and any other special requirements.

____

____

____

____

____

____

Post Test:

List any occupation or occupations that you would want to learn more about.

____

____

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B79

The booklet "The Story of Aluminum" is available from:

Aluminum Company of America
1501 Alcoa Building
Pittsburgh, Pa. 15219

When ordering specify # E 02-11952.

FOR THE STUDENT No. B-80

THE INDUSTRY

THE FOUNDRY INDUSTRY

Objective:

After studying this instructional unit, you will be able to list steps involved in the manufacture of iron castings, their special characteristics, and three of their many and varied uses.

Activity:

View the film "Cast Iron-the Biography of a Metal".

Post Test:

List three of the steps involved in the manufacture of iron castings.

1.____________________________________

2.____________________________________

3.____________________________________

Name any occupation or occupations that you saw that you would want to learn more about.

____

____

____

List the valuable characteristics of iron castings.

____

____

____

List as many of the materials in your home as you can that are produced by the foundry industry.

____

____

Extra Credit: List the foundry industries that are located in your local community.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. B-80

The film "Cast Iron-The Biography of a Metal", is available from: Graphic Services, Bureau of Mines, U. S. Department of the Interior, 4800 Forbes Avenue, Pittsburgh, Pa. 15213.

Also available from: American Foundrymen's Society,
Golf & Wolf Roads, Des Plaines, Ill. 60016

THE INDUSTRY

HISTORY OF THE FOUNDRY INDUSTRY

Objective:

After studying this instructional unit, you will be able to list three periods in the history of the foundry industry.

Activity:

1. Check out the tape "History of The Foundry Industry".
2. Read the following questions, then fill in the blanks as you listen to the tape.
    1. The foundry industry dates back to about _____B.C.
    2. Records show that the foundry industry started in China in the days of the _________ dynasty.
    3. Secrets of the foundry were passed on from ____________ to ______________.
    4. King Hiram of Tyre helped ____________________ __________________ build his temple.
    5. The Colossus of Rhodes was ___________ tall.
3. Play the tape again if you have not completed all the questions.
4. Rewind the tape, complete the Post Test and return all materials to your instructor.

Post Test:

List three periods in the history of the foundry industry.

1. ____
____
2. ____
____
3. ____
____

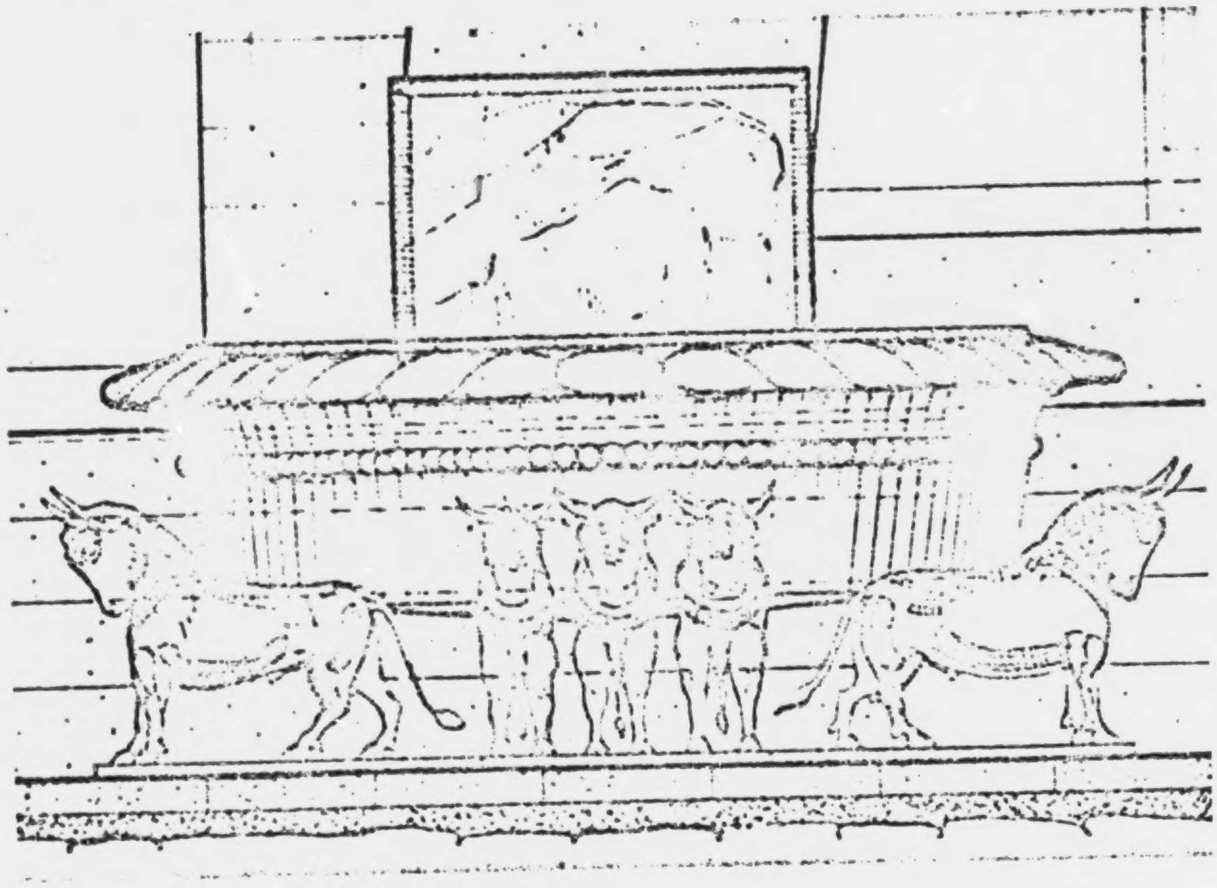
The Greek foundry men cast a statue of the sun-god. It was erected in 290 B.C., was 105 feet tall, and weighed about 360 tons. It was hollow and cast of interlocking sections. This great statue, the Colossus of Rhodes, stood guard over the harbor entrance until 224 B.C. when it fell to earth during an earthquake.

Other dates in history record the casting of cannons and other armor in times of war and water pipes and bells in times of peace. Cast iron was first cast around 600 B.C. India cast crucible steel around 500 A.D. More recent dates in the development of the foundry are: 1790-Coke was used for fuel; 1794-The invention of the cupola.

The first foundry of the new world was the Saugus Iron Works in Lynn, Mass. Paul Revere also operated a bell and cannon factory near Boston. Today it is known as the Revere Copper and Brass Company.

. . filled with wisdom
nning to work all
came to king
ll his work"

rafts it is not often
etallist is
arts.
s fr Egypt show
ting and casting.
men with tongs
e containing
it is a little clay oven.
glowing properly
taking turns with
they have pressed the
bellows by pulling
they overcame
g large objects can
painting on the left,
of a bronze door.
f the finished
te with pivots, while,
casting of a large
through the inlet
in brass" whom
st have been a master
the "brazen sea"
temple pillars.
an did the king
ground between
n" (I Kings 7:46).



"And he made a molten sea, ten cubits from the one brim to the other: it was round all about, and his height was five cubits . . . It stood upon twelve oxen" (I Kings 7:23, 25).
The "brazen sea", a huge bronze basin—this is a reconstruction—stood beside the altar of burnt offerings in the inner court of the temple. It rested on the backs of twelve oxen, which, in groups of three, faced the four points of the compass, as we are told in I Kings 7:25. Its rim "was wrought like the brim of a cup, with flowers of lilies" (I Kings 7:26). With a diameter of about seventeen feet and about half as deep this massive tank must have weighed about thirty tons. Such an enormous quantity of costly bronze sealed its own fate. In 734 B.C. King Ahaz removed the oxen from under the "sea" to pay his tribute to the king of Assyria. "And (he) took down the sea from off the brazen oxen that were under it, and put it upon a pavement of stones" (II Kings 16:17). The "brazen sea" itself "did the Chaldees break in pieces, and carried the brass of them to Babylon" (II Kings 25:13)—that happened in 587 B.C., after the capture of Jerusalem by Nebuchadnezzar.

Text of tape used for the instruction:

The Foundry Industry dates back to about 4000 B.C. There are no recordings of the exact date that man found that when certain rocks were heated, metal was produced that would take the shape of the container that it was cooled in. It is believed that these rocks were heated in open fires and the molten metal was allowed to flow into impressions in the sand.

Records show that the foundry center came into being in the days of the Shang dynasty (1766 to 1122 B.C.). China was the first to use metal casting industrially. They produced pots and pans in large quantities and were the first to keep records. Even though these records were made, these metal castings were considered an art and a craft, with the secrets of the trade passed on from father to son. As a result, by about 1000 A.D., foundry practically ceased in China.

In the meantime, the foundry industry moved toward the Mediterranean Basin. About 960 B.C., King Hiram of Tyre helped King Soloman build his temple. Among King Hiram's craftsmen was a worker in brass that made the "Brazer sea". The "Brazer sea" was a huge bronze basin about seventeen feet in diameter and about half as deep. It rested on the backs of twelve bronze oxen, which in groups of three faced the four points on a compass. Some of the temples pillars were also cast of bronze.

FOR THE STUDENT

No. B82

THE INDUSTRY

SAND CASTING

Objective:

After viewing this instructional package you will be able to identify the proper foundry terms for the parts of a sand mold. Given a work-sheet, you will list these terms in the proper space provided.

Activity:

View the transparency - "The Sand Mold".

List the terms used.

______________ ______________ ______________

______________ ______________ ______________

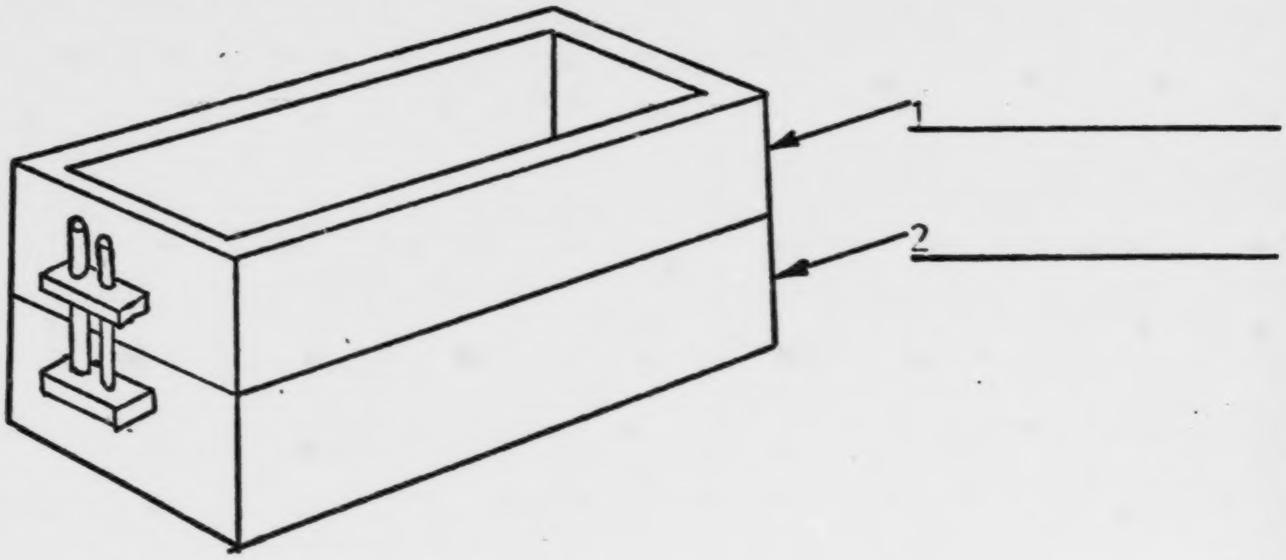
______________ ______________ ______________

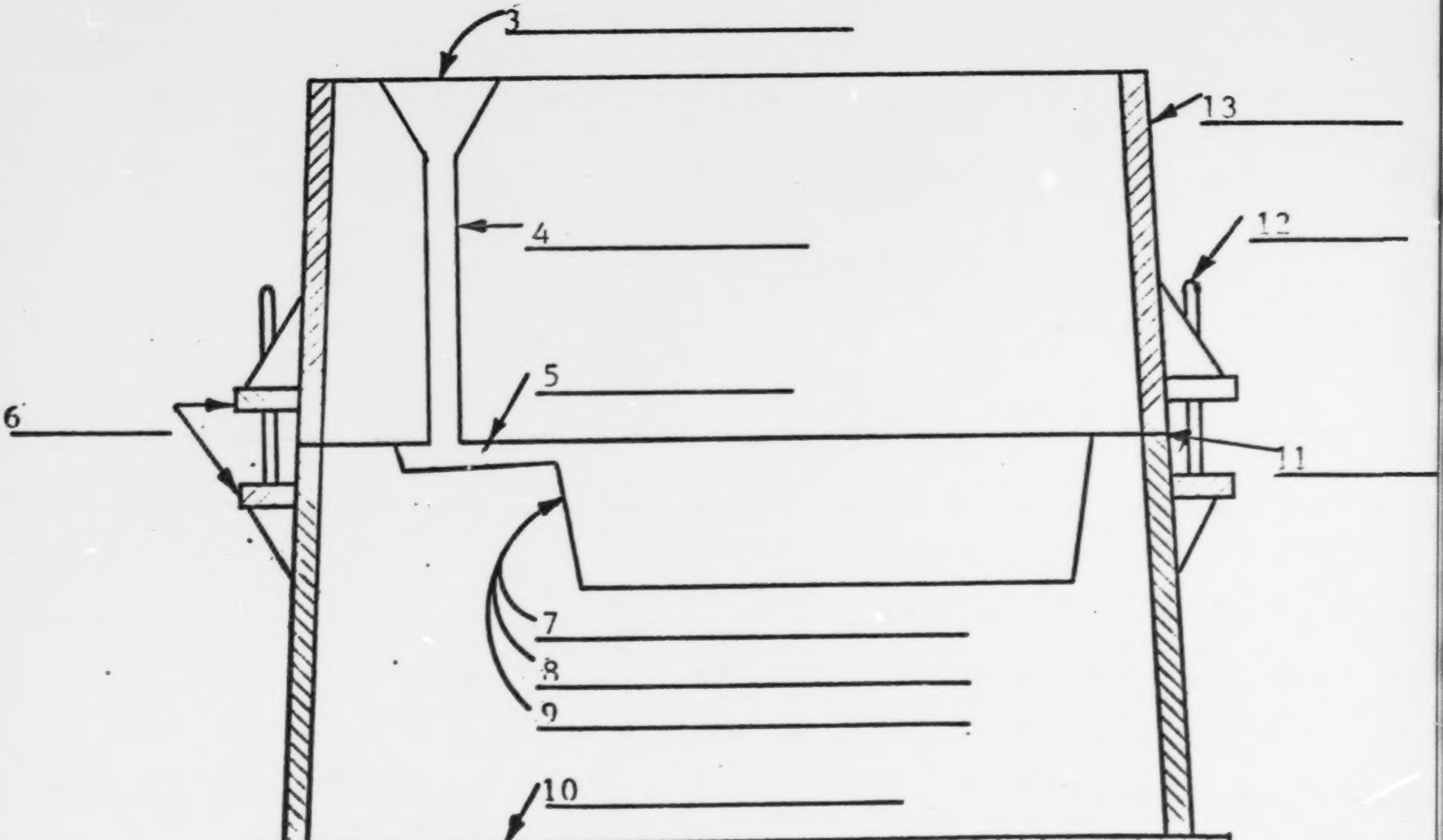
Post Test:

Using the list that you completed, insert the proper terms in their proper place on the work sheet provided. Return all materials to your instructor.

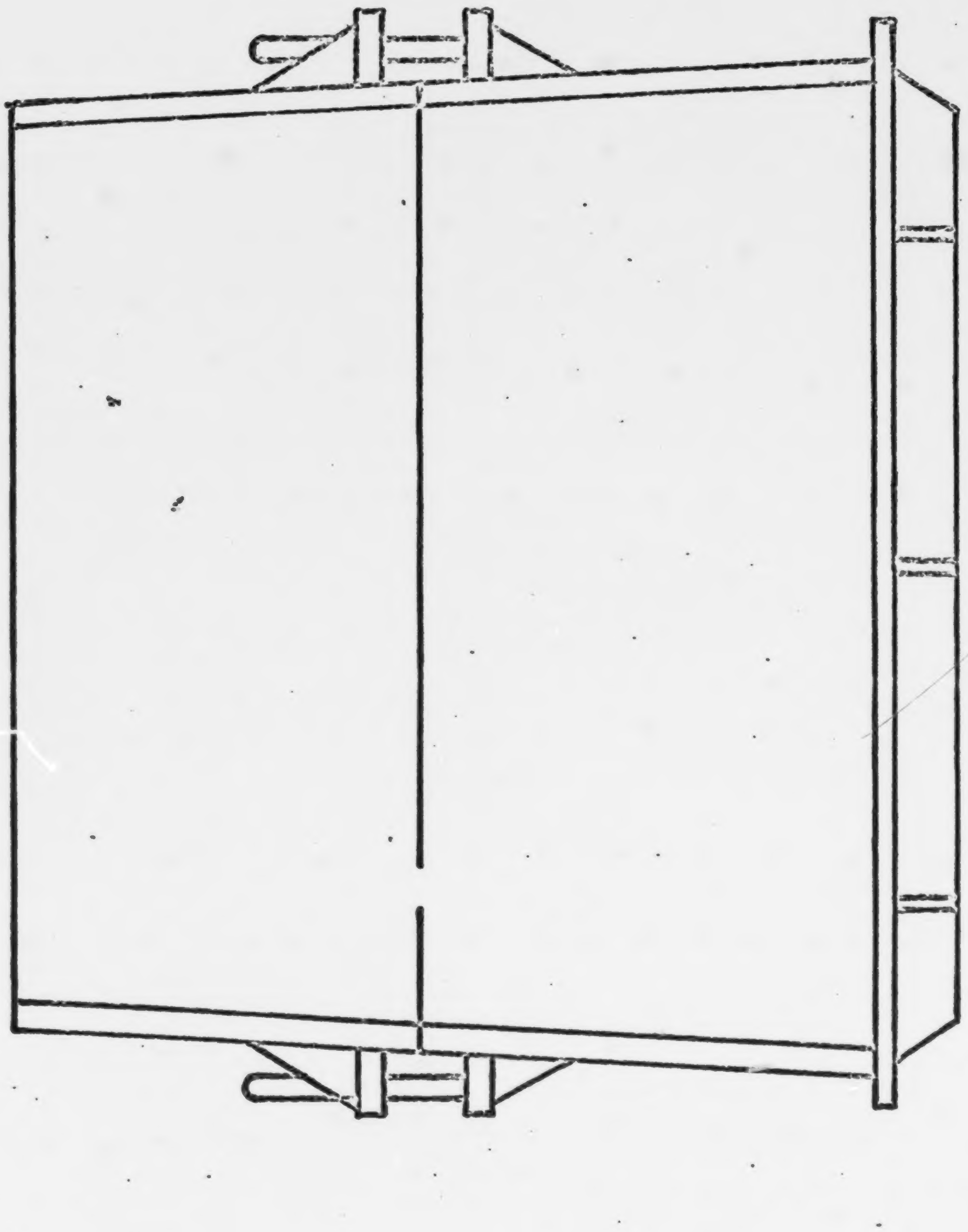
Name---------------------------

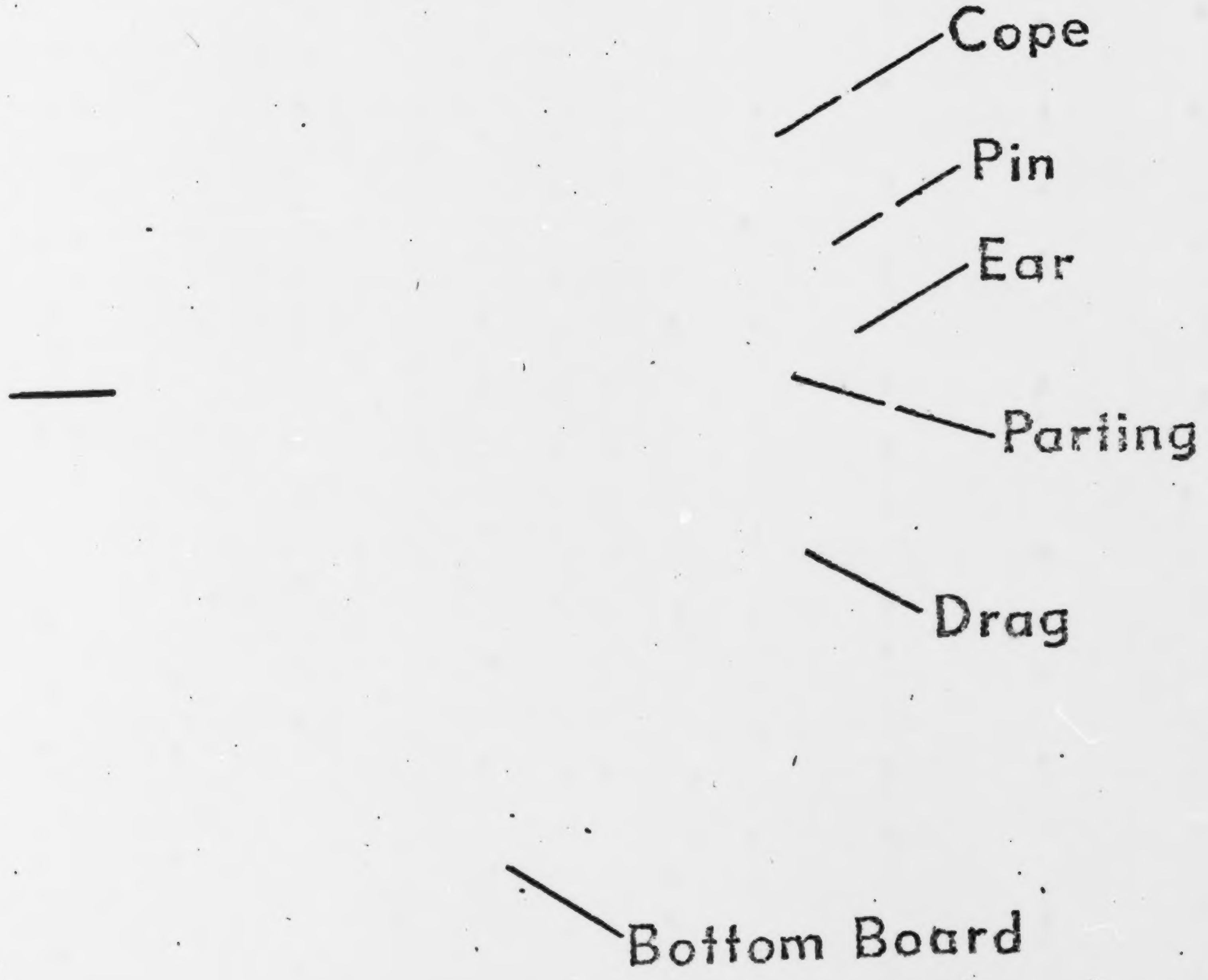
Insert the proper terms for the areas or parts pointed out in the drawings below.

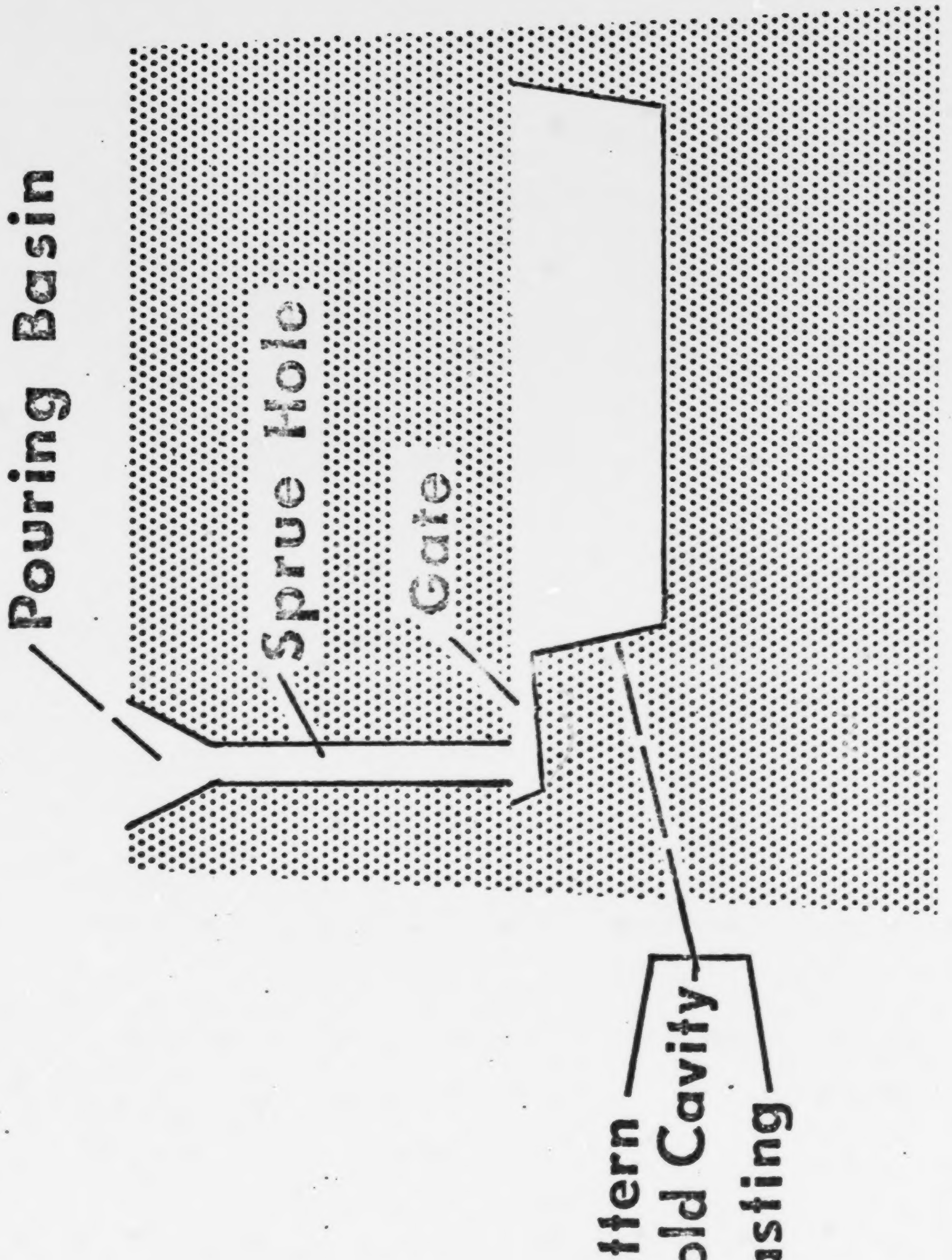



3
4
5
6
7
8
9
10
11
12
13

The transparency may be made from pages 3, 4, & 5 or use them as a guide.




Cope
Pin
Ear
Parting
Drag
Bottom Board


Pouring Basin
Sprue Hole
Gate
Pattern
Mold Cavity
Casting

THE INDUSTRY

OTHER MOLDING PROCESSES

Objective:

You will select a molding process you want to learn more about.
You will research your selection.
You will write a report, one-half to one page, on your selected process.

Activity:

View the film "Straight Line to Production". This film gives a very good review of green sand molding. It also shows seven other basic processes used to produce castings. They are dry sand, shell molding, core sand, permanent molding, ceramic mold, investment, and centrifugal.

Post test:

Select one of the molding processes that you want to learn more about. Research your selection, using a text or the encyclopedia. Write a report, one-half to one page in length on your selected process.

The film, "Straight Line to Production" is available on free loan from:

Gray and Ductile Iron Founders' Society, Inc.
930 National City East Sixth Building
Cleveland, Ohio 44114

THE INDUSTRY

CAREERS IN THE FOUNDRY INDUSTRY

Objective:

You will write a report on one of the occupational opportunities in the foundry industry.

Activity:

1. The foundry industry provides many opportunities for employment. The skills and education needed vary from one type of job to the next. There are many job opportunities available to you with a high school education, and even greater opportunities with further education.

2. View the filmstrips I. "Cast Metals Careers" (High School Graduates) and II. "Cast Metals Careers" (College Graduates).

3. Make a list of any occupation or occupations that you would like to learn more about.

    ____

    ____

Post Test:

From the list you have made, select one occupation and write a short report (not more than two pages) that includes:

1. Nature of the work.
2. Requirements and Qualifications.
3. Growth opportunities.
4. Working conditions
5. Earning power.

Check with your instructor, librarian, or guidance counselor for any career pamphlets that may be available.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B89

Filmstrip I "Cast Metals Careers" (High School Graduates). Filmstrip II "Cast Metals Careers" (College Graduates) are available on free loan from:

AFS Training and Research Institute
Golf and Wolf Roads
Des Plains, Ill. 60016

They also have career pamphlets available on:

Patternmaking

Melting & Pouring

Molding

Coremaking

Engineering

Cleaning & Finishing

Sales-Equipment & Castings

Technicians

Equipment Maintenance

FOR THE STUDENT No. B90

THE INDUSTRY

POWDERED METALLURGY

Objective:

You will be able to arrange in the proper order, the operations performed in the production of a product using powdered metallurgy.

Activity:

1. Study "This is Carboloy".
2. Make a list of the processes used to produce a product from powdered metals.

____

____

____

____

____

____

____

____

____

____

____

____

____

Post test:

Place numbers in the blanks to show their order of events in the production of a product using powdered metallurgy.

_____ Pre-sintering

_____ Forming machines

_____ Adding a binder

_____ Carburizing

_____ Sintering

_____ End product testing

_____ Compacting

_____ Checking partical size

_____ Blending

"This is Carboloy" is available in printed form and also as a filmstrip with sound to be shown on a DuKane projector. The sound portion may be transferred to tape if you so desire. For more information, write to:

General Electric Company
Metallurgical Product Department
11177 8 Mile Road
Warren, Michigan 48089

Answers for Post test:

_6_ Pre-sintering

_7_ Forming machines

_4_ Adding a binder

_3_ Carburizing

_8_ Sintering

_9_ End Product testing

_5_ Compacting

_1_ Checking partical size

_2_ Blending

FOR THE STUDENT

THE INDUSTRY

MANUFACTURE OF METAL POWDERS

Objective:

You will list the methods used to produce metal powders.

Activity:

1. Check out a text from your instructor or librarian on materials and manufacturing. Roy A. Lindberg's book, "Materials and Manufacturing Technology", is a good example.
2. Using the text, look up the section on powder metallurgy.
3. Define the following terms in relation to metal powders.

Atomization ______________________________

____

____

Reduction ______________________________

____

____

Electrolysis ______________________________

____

____

Post test:

List three (3) methods used to produce metal powders.

____

____

____

THE INDUSTRY

APPLICATIONS OF POWDERED METALLURGY

Objective:

You will list characteristic advantages of making a product of powdered metals.

Activity:

1. Read this list of properties of metal powders and finished parts.

    a. Powder metallurgy makes it possible to unite materials that cannot be alloyed in the usual sense or would not yield the desired characteristics if they were joinded mechanically.

    b. Particle size and distribution are important factors in the control of porosity, density, and compressibility.

    c. The apparent density of the material is determined from the variation in the particle size.

    d. Through controllable density, one area of a part can be made hard and dense while another portion of the same piece is soft and porous.

    e. Pressed and sintered ferrous parts can be controlled to about ±0.002 in. per in. on diameters and other dimensions formed by the die. Sizing can be used to cut this tolerance in half.

    f. When self-lubricating properties are desired, the sintered parts are impregnated with oil, grease, wax, or other lubricating materials.

    g. Infiltration provides increased strength, hardness, and density not obtainable by straight sintering.

2. Using the list above, list those properties that you think were used in the selection of powdered metallurgy to make a bearing for an electric motor.

____

____

____

Post test:

List the properties that you think were used in the selection of this process to make a filter for the gas line of an automobile.

FOR THE STUDENT No. B101

THE INDUSTRY

COMPOSITION OF PLASTICS

Objective:

1. You will perform identification tests on thermoplastic materials.
2. You will identify the material you are testing by comparing your results to a chart that is furnished.

Activity:

1. Select five (5) samples of materials to be tested.
2. Go to the testing area and try to burn each test sample. CAUTION: HOLD TEST SAMPLES IN TONGS OR PLIERS, DO NOT TOUCH THE HOT PLASTIC!!!!!
3. Observe the flame, flame color, smoke, and other reations to burning.
4. Using the chart provided, list the name of the material for the test sample.
5. Clean all tools and materials that you used before turning in your papers to your instructor.

Post test:

Using the chart, name the five (5) test samples.

Sample # 1____

Sample # 2____

Sample # 3____

Sample # 4____

Sample # 5____

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. B101

Samples of plastic materials may be made from any plastic scraps of thermoplastic materials. Broken toys, disposable plastic bottles, etc. work very well. Try to make up a good collection of various materials. Samples should be kept small, about 1/8 to 1/4 inch wide and not more than 2 inches long.

The test area: It is recommended that these tests be performed over a pan of water. Matches, torch, etc. may be used as a heating device.

The chart "A Guide to the Identification of Thermoplastic Materials" is available from:

E.I. DU PONT DE NEMOURS & CO, (INC.)
Plastics Department
Wimington, Delaware 19898

or from: E.I. DU PONT DE NEMOURS & CO, (INC.)
Plastics Department
26300 Northwestern Highway
Southfield, Michigan 48075

FOR THE STUDENT

No. B102

THE INDUSTRY

PROPERTIES OF PLASTICS

Objective:

All plastics fall into one of two groups: thermoplastic or thermosetting. You will match the distinguishing properties of each to the proper group classification.

Activity:

1. Study transparencies PLA 1, PLA 2, and PLA 3.
2. Define plastics. ______________________________

   ____

   ____

3. Define thermoplastics. __________________________

   ____

   ____

   ____

4. Define thermosetting plastics. ____________________

   ____

   ____

   ____

Post test:

1. Using a pencil draw a line between thermoplastic and it's definition.
   Using a pen draw a line between thermosetting and it's definition.

THERMOPLASTIC	Reheating will not soften the material.
THERMOSETTING	Becomes soft when reheated, hardens when cooled.

2. If you are unable to complete the Post test, check out a copy of "The Story of The Plastics Industry" from your instructor or librarian. Read pages 6 and 7. Then try again.

3. Return all materials to their proper place.

"Plastics Technology Transparencies" and a teacher's guide are available from:

DCA EDUCATIONAL PRODUCTS INC.
4865 Stenton Avenue,
Philadelphia, Pa. 19144

"The Story of The Plastics Industry" is available from:

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.
Public Relations Department
250 Park Avenue,
New York, N. Y. 10017

FOR THE STUDENT No. B103

THE INDUSTRY

PROCESSING PLASTICS

Objective:

You will list five (5) products made of plastics that you may find in your home. You will then list the process used to make each product you listed.

Activity:

1. Study transparencies PLA 9 through PLA 20. (See Package B 102).

2. Make a list of the processes and a product that is made by that process.

PROCESS	PRODUCT

3. If you would like to read more information about processing plastics, check out a copy of "The Story of The Plastics Industry" and read pages 33 through 40.

Post test:

List five (5) products in your home that are made of plastic. Name the process, from the list above, that was used to make the product.

PROCESS	PRODUCT
1.____________________	____________________
2.____________________	____________________
3.____________________	____________________
4.____________________	____________________
5.____________________	____________________

FOR THE STUDENT No. B109

THE INDUSTRY

OPPORTUNITIES IN THE FIELD OF PLASTICS

Objective:

You will list an occupational opportunity the plastics field offers to men and/or women that you want to learn more about.

Activity:

1. Study transparency PLA 21. (See Package B102)
2. Read Pages 1 through 5 in "The Story of The Plastics Industry".
3. Look through the help wanted ads in the newspaper. Select five (5) ads pertaining to labor in the field of plastics and fasten them to this sheet.

Post test:

List an occupation or occupations that you want to learn more about.

____

____

FOR THE STUDENT

No. B110

THE INDUSTRY

THE USES OF PLASTICS IN THE HOME

Objective:

You will list three (3) products or parts of products made of plastics that are found in the home.

Activity:

After looking through magazines, cut out five (5) to ten (10) pictures of products or parts of products that are made of plastics and are intended to be used in the home. Fasten them to the back of this paper.

Post test:

List three (3) products or parts of products that are made of plastics that are found in the home.

FOR THE STUDENT No. B111

THE INDUSTRY

THE USES OF PLASTICS IN INDUSTRY

Objective:

You will list three (3) products or parts that are made of plastics that are used in industry.

Activity:

Study the tools and machines in your class room.

List two (2) or more parts of a car that are made of plastics.

____

____

____

List any products or parts of machines that are made of plastics.

____

____

____

List two (2) or more uses of plastics in the field of electricity and electronics.

____

____

____

____

Post test:

List three products or parts of products that are made of plastics that are used in industry.

____

____

____

THE INDUSTRY

CAREERS IN INDUSTRY

Objective:

You will select an occupation or occupations that you would like to learn more about.

Activity:

1. Check out a copy of "Careers" from your instructor or your librarian.
2. Study the literature very carefully noting the following:

Opportunities in Manufacturing

Opportunities in hourly careers

Opportunities in salaried careers

The retail automotive business

Sources of career information

NOTE: This information has been organized around the automotive industry. Many of the occupations explained are NOT LIMITED to only the automotive industry.

Post test:

Select an occupation or occupations that you would like to learn more about.

Check again under sources of career information and write for any additional information that may be available.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. B120

"Careers" is a booklet that is available free of charge from:

Educational Affairs Department
Ford Motor Company
The American Road
Dearborn, Michigan 48121

FOR THE STUDENT No. B121

THE INDUSTRY

SKILLED AND TECHNICAL OCCUPATIONS IN INDUSTRY

Objective:

You will select an occupation or occupations that you would like to learn more about.

Activity:

1. Check out a copy of "A Career in Metallurgy Will Extend Your Reach".
2. Study the literature very carefully noting the following:

   Knowledge of materials is the starting point.

   Knowledge of materials can extend your reach.

   If you want to do research ....

   If you want to produce metals ....

   If you want to create products ....

   If you want to teach ....

   If you want to reach in other directions.......

   Opportunities are unlimited ....

Post test:

Select an occupation or occupation that you would like to learn more about.

Check with your Guidance counselor to see if he has any materials that may help you make your decision.

Write to industry in your community to see what they have to offer in occupational information.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. B121

"A Career in Metallurgy Will Extend Your Reach" is available from:

Career Guidance Department
American Society for Metals
Metals Park, Ohio 44073

THE INDUSTRY

ENERGY

OBJECTIVE: Given this package, you will define energy, power, and force and state the difference between each.

ACTIVITY: STUDY INFORMATION BELOW.
Do not confuse energy, power, and force.

ENERGY is the name given to the ability to do work. All human life depends upon the energy in the universe. Most of the energy on earth comes from the sun. It travels from the sun to the earth in the rays which the sun gives off. The sun's rays are needed so that plants can make food. The food that plants make is the food on which all the animals in the world depend for life. Man and animals use the energy found in food to operate their bodies.

POWER measures the rate at which work is done. Work can be done slowly, or it can be done rapidly. A machine that does a great deal of work in a short time is called a high-powered machine. A machine that takes much longer to do a comparatively small amount of work is a low-powered machine.

FORCE is the cause of movement. Work is done when force is applied causing an object to move. Force generally takes the form of a push, a pull, or a lift.

POST TEST: Give an example of power, energy, and force.

THE INDUSTRY

ENERGY

OHM'S LAW

OBJECTIVE: Given the correct formulas, you will calculate voltage, current and resistance.

ACTIVITY: STUDY THE INFORMATION BELOW.

Ohm's law is used when it is necessary to calculate voltage, current and/or resistance.

In your calculations substitute as shown below.

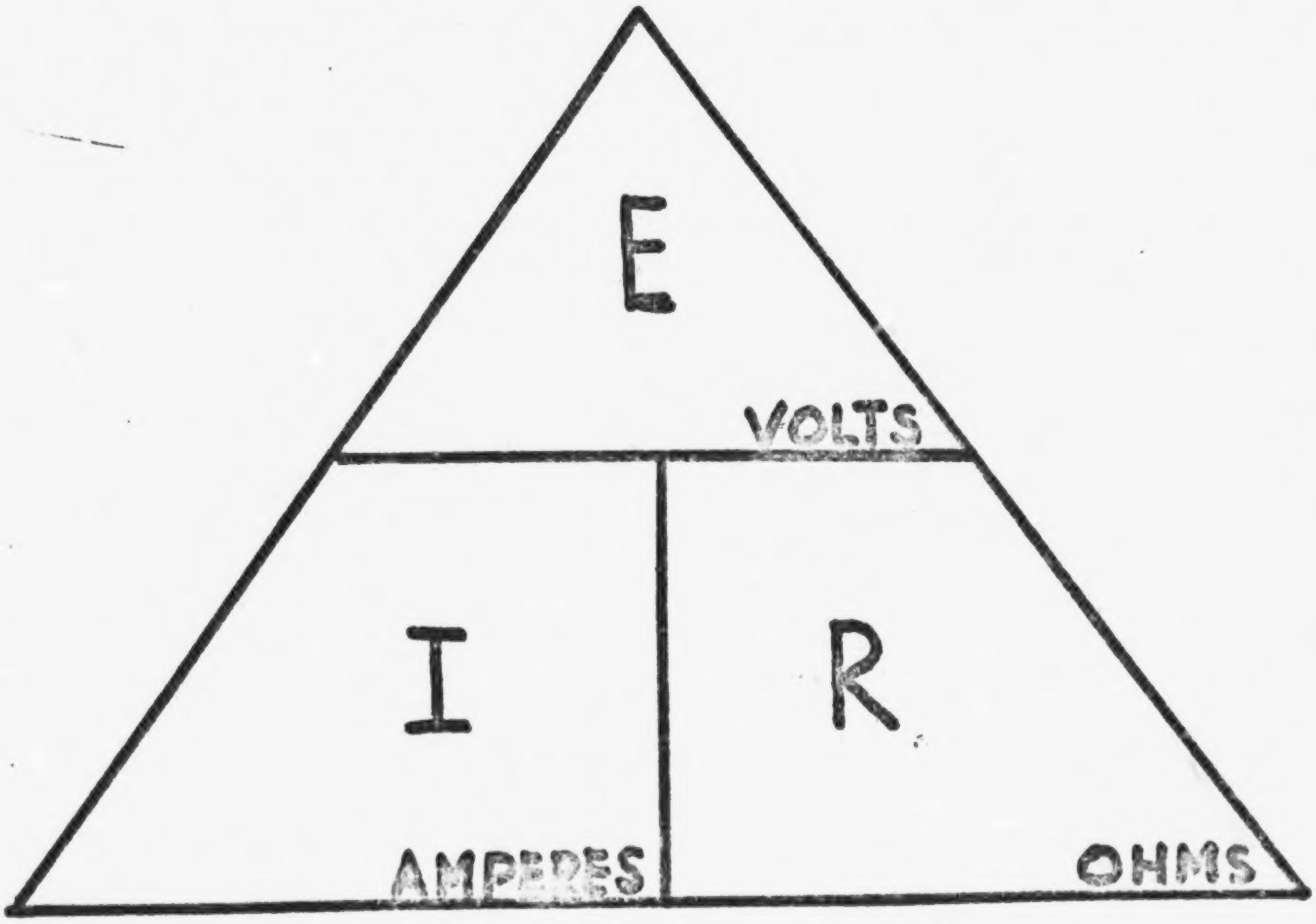
E = Voltage - measured in volts.
I = Current - measured in amperes.
R = Resistance - measured in ohms.

POST TEST: Refer to formulas on page 2.

Find the voltage in a circuit of 4 amperes flowing through a resistance of 60 ohms.

Find the resistance of a circuit with a voltage of 220 volts and a current of 10 amperes.

OHM'S LAW


E
VOLTS
I
AMPERES
R
OHMS

$$E = I \times R$$

$$I = \frac{E}{R}$$

$$R = \frac{E}{I}$$

THE INDUSTRY

TEACHER REFERENCE SHEET FOR B160 SERIES OF PACKAGES

McGraw-Hill Publishers have the following films and film strips that may be used to supplement the B160 series.

Complete details are available from

McGraw-Hill Text-Film Division
New York, St. Louis, San Francisco, or Dallas.

Films:
- Electric Circuits (13 min. b/w)
- Magnetism (13 min. b/w)

Filmstrips:
- Distributing Electric Power (49 Fr. b/w)
- Electric Current Measurement (40 Fr. b/w)
- Electric Current Principles (40 Fr. b/w)
- Electrons Produce Our Light (42 Fr. color)
- Guages and Wiring (40 Fr. b/w)
- How Batteries Work (42 Fr. color)
- How Television Works (49 Fr. b/w)
- How We Get Our Electricity (40 Fr. b/w)
- Principles of Electromagnetism (40 Fr. b/w)
- Switches, Relays, and Lights (40 Fr. b/w)
- Using Electricity Safely (34 Fr. b/w)
- What Is Electronics? (49 Fr. color)

STUDENT PACKAGE

THE INDUSTRY

PRINCIPLE OF JET PROPULSION

Objective:

Given a small balloon, you will use the balloon to demonstrate the principle of jet propulsion.

Activity:

Inflate balloon.

Release balloon in air.

Observe balloon's action.

Try and relate the balloon's action to what you think happens as a jet is propelled through the sky.

Check your explanation with teacher to see if you understand the principle.

This lesson is designed to excite and arouse the curiosity of the student as to how a jet is propelled.

Objectives of the lesson are met if student learns that a jet is propelled by taking air in the front and expelling air from the rear of the engine.

How Does a Jet Plane Work?

A jet has no propeller. It shoots a jet of hot gases toward the rear at high speed, and the reaction to this yet drives the plane forward. It is the same principle as the fired forward, or the action of an inflated balloon when released in the air when the air escaping.

It is recommended that you obtain and show the following film to your class before you have the students attempt the experiment.

ABC's of Jet Propulsion
General Motors Corporation
West Grand Blvd. and Second Ave.

THE INDUSTRY

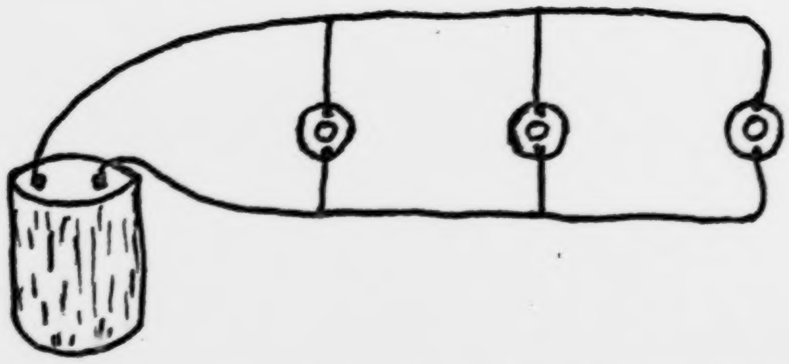
A SIMPLE PARALLEL CIRCUIT

OBJECTIVE: Given this lesson, you will connect a simple parallel circuit.

ACTIVITY: Get the following:

- Bell wire
- 1½ volt dry cell
- 3 light bulbs
- 3 sockets

Connect the circuit shown below.



NOTE: In a parallel circuit, the lights are connected between the two wires connected to the power source. Removing or disconnecting one bulb does not cause the others to go out because the circuit is not broken.

FOR THE STUDENT

THE INDUSTRY

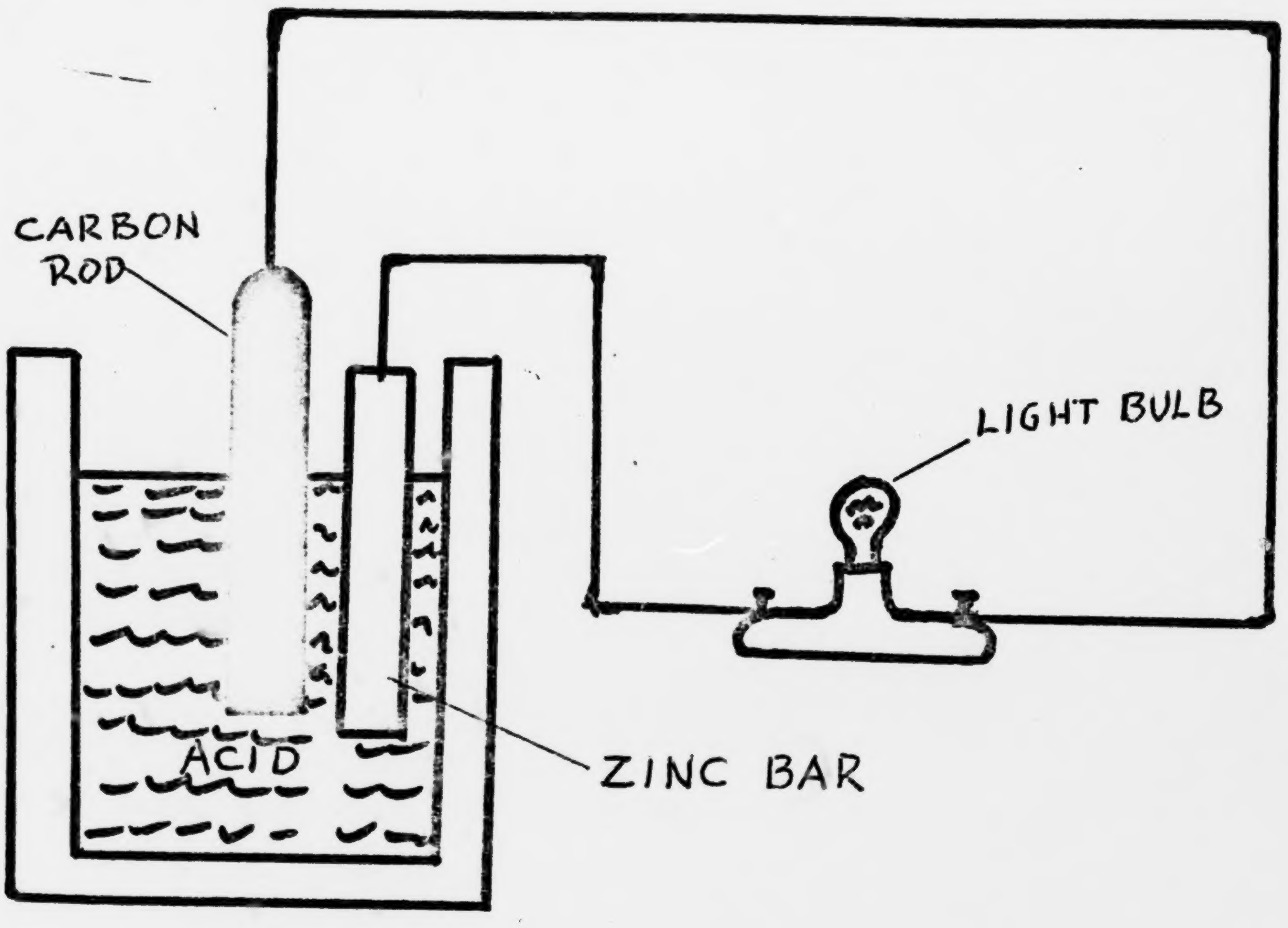
ELECTRIC ENERGY (WHERE IT COMES FROM)

OBJECTIVE: Given directions, you will be able to describe verbally how a battery cell is made from zinc, carbon and acid.

PREREQUISITE: Package on Series Connection - B163

ACTIVITY:

1. Secure:
    - 1 glass jar
    - 1 zinc rod
    - 1 carbon rod
    - 1 light socket
    - 1 bulb
    - wire connectors
    - 1 small jar of Sulfuric Acid
2. Fill the glass jar 1/4 full of water
3. Add same amount of acid.
4. Place the carbon and zinc rod into the solution.
5. Connect a small flash light bulb in series with the rod.
6. Your cell should be connected like the diagram on page 2.


CARBON ROD
LIGHT BULB
ACID
ZINC BAR

NOTE: This cell will produce a dim glow.

Produce more cells, hook in series, and light will shine brighter.

TEACHER REFERENCE SHEET

For this package the student will need the following:

1 glass jar
1 zinc rod
1 carbon rod
1 light socket
1 bulb
1 small jar of Sulfuric Acid
wire connectors

FOR THE STUDENT

THE INDUSTRY

ENERGY

SERIES CONNECTION

OBJECTIVE: Given instructions, you will connect a series circuit.

PREREQUISITE: Package H40

ACTIVITY:

1. Secure: 3 light sockets
   3 light bulbs
   3 socket boxes
   wire connectors
   extension cord

2. Connect the circuit as shown on next page.

3. When circuit is complete, have teacher check it.

4. Plug into power source.

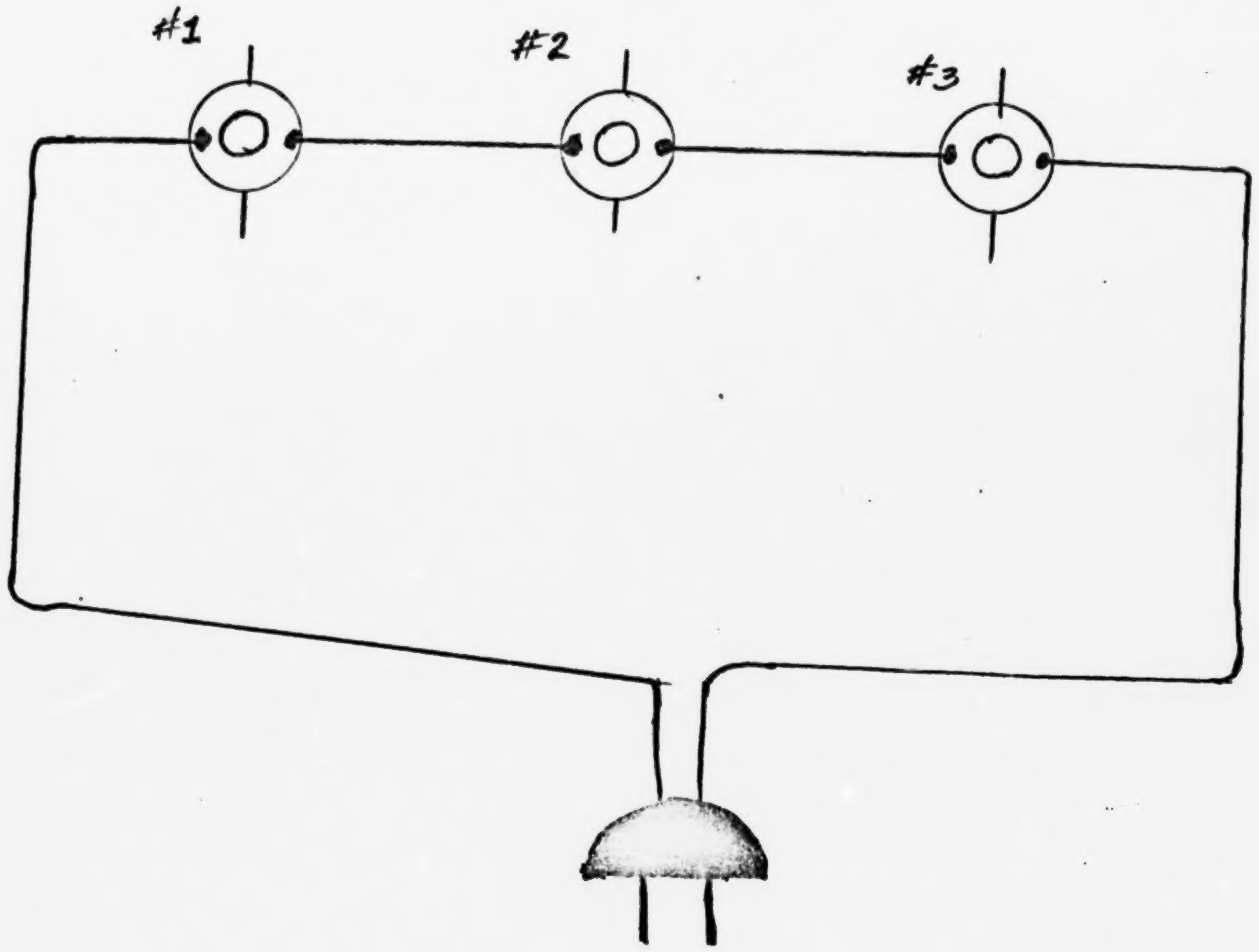
5. Disconnect one of the bulbs. What happens to the other two lights? Do they get dim or brighter?

6. Disconnect another bulb. Does the last light shine dimmer or brighter?

7. If everything was done correctly, each remaining light should shine brighter as lights are disconnected.

8. You have learned the principle of how a series circuit works.

The voltage is divided equally across all resistors, and as each resistor is removed from the circuit the voltage is divided equally across those remaining.



THESE THREE BULBS ARE CONNECTED IN SERIES.

THE INDUSTRY

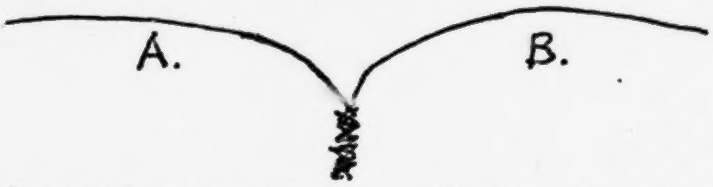
ENERGY FROM HEAT

OBJECTIVE: Given this experiment, you will state the role heat plays in causing a chemical reaction that produces electrical energy.

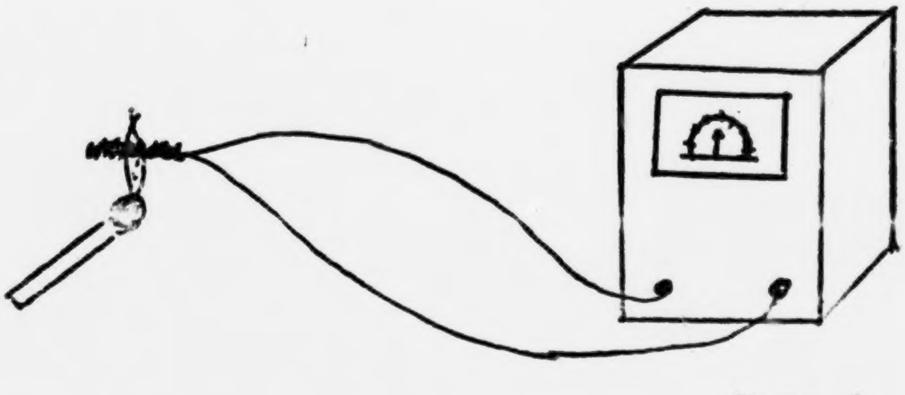
PREREQUISITE: Package B152

ACTIVITY:

1. Get: (A). a piece of iron wire
   (B). a piece of copper wire
2. Heat wires separately. Connect one to Galvanometer. Is there a reading?
3. Connect other wire to Galvanometer. Is there a reading?
4. Twist the ends of the wire tightly together.



5. Connect the other ends to a Galvanometer.
6. Is there a reading? Yes_____ No_____
7. Light a match and hold the flame under the twisted joint.



ENERGY FROM HEAT

8. Is there a reading? If so, record it.

As the wires are heated, you will notice a small voltage reading on the meter.

Heat causes a reaction between the two metals. This reaction produces electricity.

FOR THE STUDENT

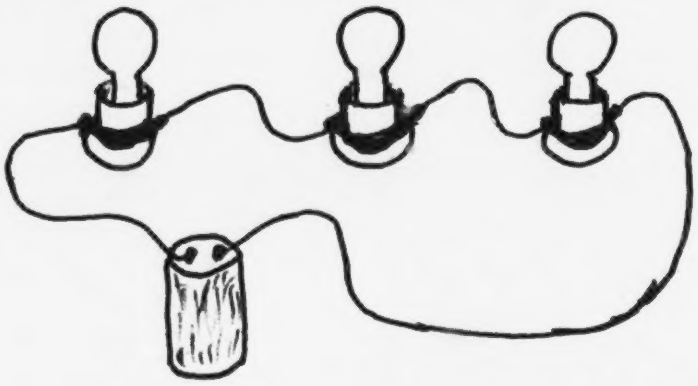
THE INDUSTRY

THE SERIES CIRCUIT

OBJECTIVE: Given this lesson, you will connect a series circuit.

ACTIVITY: 1. Get the following materials:
- 3 sockets
- 1 battery or 1½ volt source
- bell wire
- 3 - 1½ volt light bulbs

2. Connect the circuit shown below.



3. Have your connections checked by the teacher.

4. Remove one bulb. What happens?

5. Replace the bulb. What happens?

6. Repeat this procedure with each bulb.

In a series circuit, there is only one path through which electrons can flow. If the circuit is broken at any point, the flow of electrons stops. This is why all the bulbs connected in series go out when one of them is disconnected.

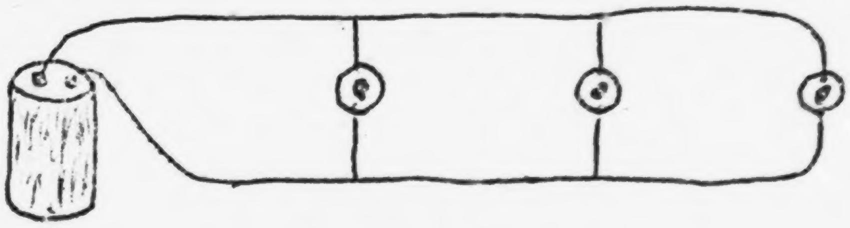
THE INDUSTRY

THE PARALLEL CIRCUIT

OBJECTIVE: Given this lesson, you will connect a parallel circuit.

ACTIVITY:

1. Get the following materials:
   - 3 sockets
   - 1 battery or 1½ volt source
   - bell wire
   - 3 - 1½ volt light bulbs
2. Connect the circuit shown below.



3. Have your connections checked by the teacher.
4. Remove one bulb. What happens?
5. Replace the bulb, and repeat the procedure with each bulb.

In a parallel circuit, the loads are placed between the two wires connected to the source of power. If one load is removed, the flow of electrons continues. This is why bulbs connected in parallel continue to glow when one is removed from a circuit.

THE INDUSTRY

DEFINITIONS OF ELECTRICAL TERMS

OBJECTIVE: Given these definitions, you will define 5 electrical terms.

ACTIVITY: STUDY MATERIAL BELOW.

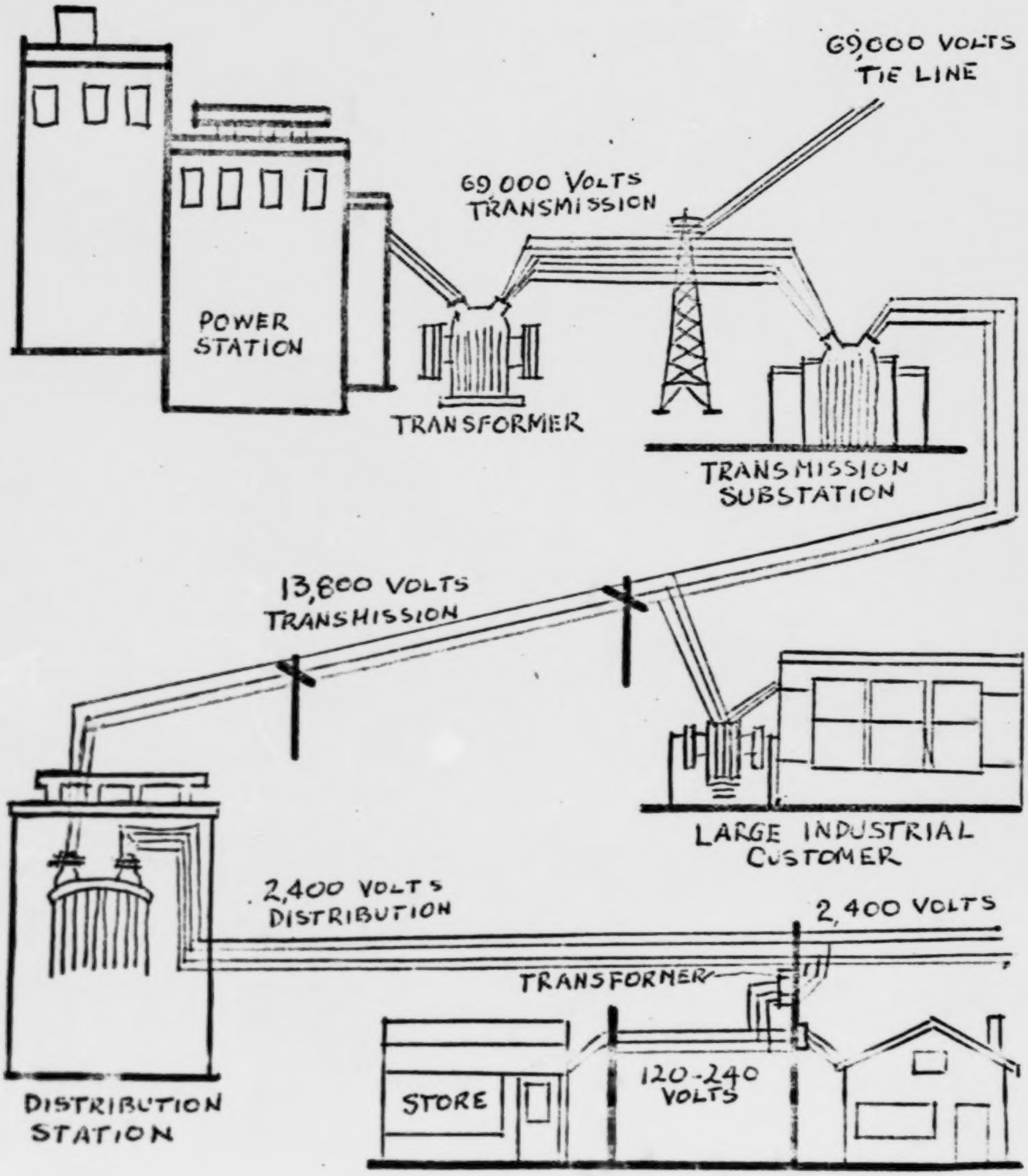
TERM	DEFINITION	EXPLANATION
Ampere	Unit of electric current intensity	Commonly used to express an amount of electric current
Volt	Unit of electric pressure	Rate of pressure exerted on current flowing through a wire
Watt	Unit of electric power	The product of amperes and volts or working electric energy
Watt-hour	One watt used for one hour	The measurement of electric energy used
Kilowatt-hour	1,000 watt-hours	The term used to show amount of electric energy

THE INDUSTRY

TRANSMITTING ELECTRICAL ENERGY

OBJECTIVE: Given this diagram, you will trace electrical power from the source to the users.

ACTIVITY: STUDY THIS DIAGRAM.


69,000 VOLTS
TIE LINE
69 000 VOLTS
TRANSMISSION
POWER
STATION
TRANSFORMER
TRANSMISSION
SUBSTATION
13,800 VOLTS
TRANSMISSION
LARGE INDUSTRIAL
CUSTOMER
2,400 VOLTS
DISTRIBUTION
2,400 VOLTS
TRANSFORMER
DISTRIBUTION
STATION
STORE
120-240
VOLTS

THE INDUSTRY

THE GROWTH TREE OF ELECTRICITY

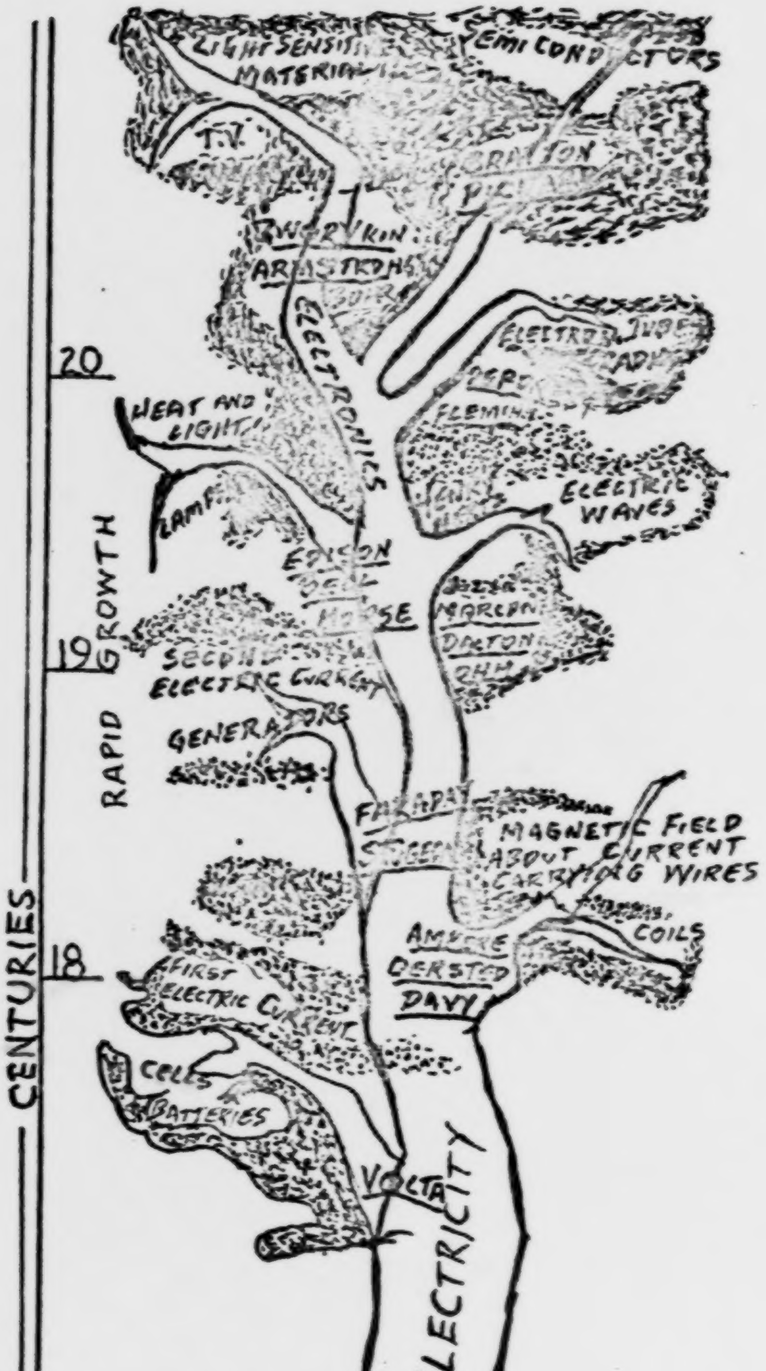
OBJECTIVE:

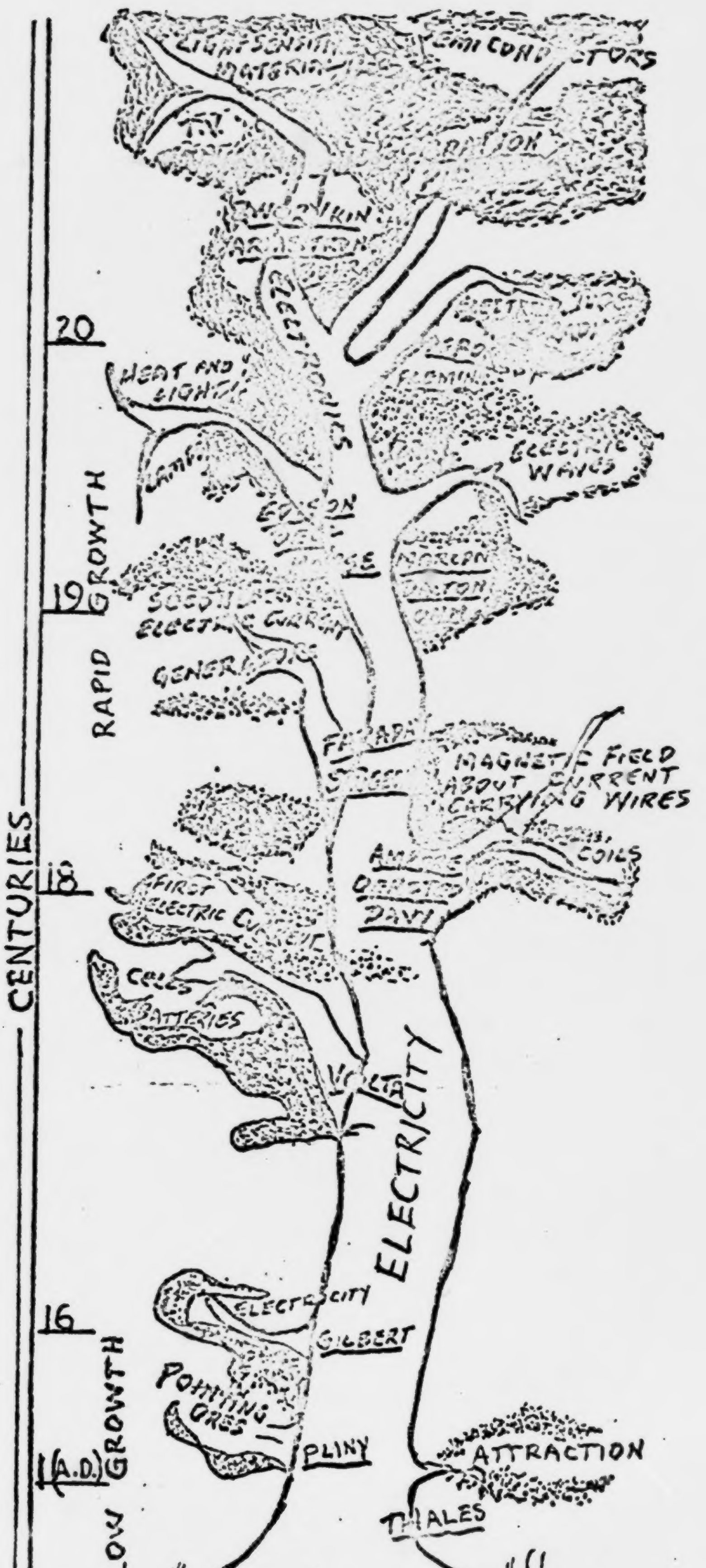
Given this diagram, you will trace the growth of electricity from 1 B.C.

ACTIVITY:

Start at the trunk of the tree and trace the progress and developments in electricity up to and including the twentieth century.

See how many names of scientists and discoveries you recognize.


LIGHT SENSITIVE MATERIAL
SEMICONDUCTORS
T.V.
ZWORYKIN
ARMSTRONG
ELECTRONICS
ELECTRON TUBE
FLEMING
ELECTRIC WAVES
HEAT AND LIGHT
LAMP
EDISON
BELL
MORSE
MARCONI
DALTON
OHM
SECOND ELECTRIC CURRENT
GENERATORS
FARADAY
MAGNETIC FIELD ABOUT CURRENT CARRYING WIRES
COILS
AMPERE
OERSTED
DAVY
FIRST ELECTRIC CURRENT
CELLS
BATTERIES
VOLTA
ELECTRICITY
ELECTRICITY
GILBERT
POINTING ORES
PLINY
ATTRACTION
THALES
CENTURIES
20
19
18
16
1(A.D.)
1(B.C.)
RAPID GROWTH
SLOW GROWTH


LIGHT SENSITIVE MATERIALS
SEMI CONDUCTORS
T.V.
ELECTRONICS
HEAT AND LIGHTING
ELECTRIC WAVES
FLEMING
EDISON
OHM
ELECTRIC CURRENT
GENERATORS
FARADAY
MAGNETIC FIELD ABOUT CURRENT CARRYING WIRES
COILS
AMPERE
OERSTED
DAVY
FIRST ELECTRIC CURRENT
CELLS
BATTERIES
VOLTA
ELECTRICITY
ELECTRICITY
GILBERT
POINTING ORES
PLINY
ATTRACTION
THALES
CENTURIES
20
19
18
16
1 (A.D.)
1 (B.C.)
RAPID GROWTH
SLOW GROWTH

THE INDUSTRY

ENERGY

PARALLEL CONNECTION

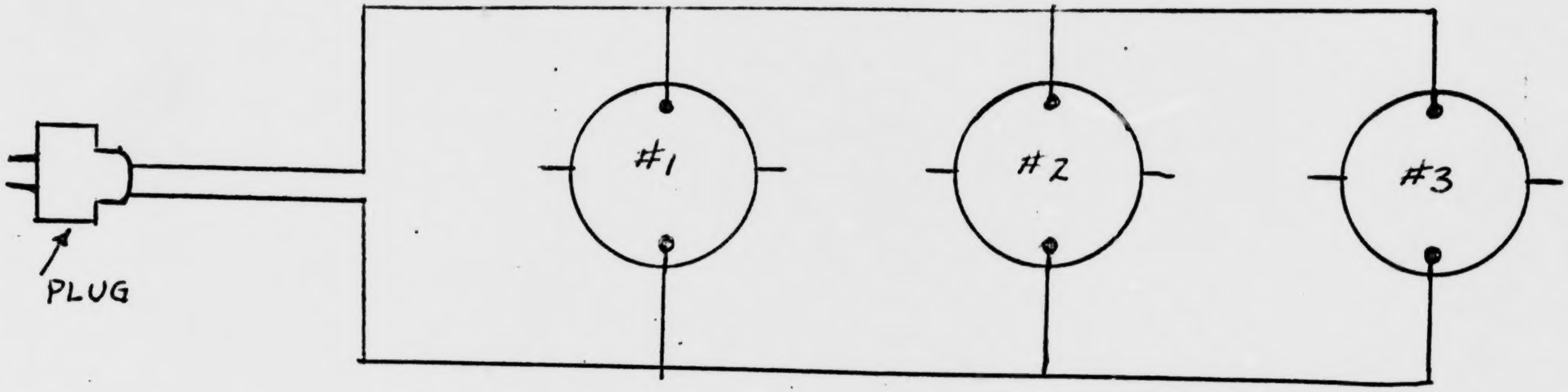
OBJECTIVE: Given instructions, you will connect a parallel circuit.

PREREQUISITE: Package H40

ACTIVITY:

1. Secure:
   - 3 light bulbs
   - 3 light sockets
   - 3 socket boxes
   - wire connectors
   - wire
2. Connect the circuit as shown on next page.
3. When the circuit is complete, have teacher check it.
4. Connect to power source.
5. Disconnect one of the bulbs. What happens to the other two lights? Do they become dim or brighter?
6. Disconnect another bulb. What happens?
7. If everything was done correctly, there was no change in brightness as lights were disconnected.
8. You have learned the principle of how a parallel circuit works.

Adding resistors to or removing resistors from a parallel circuit does not affect the voltage.



THIS CIRCUIT SHOWS 3 LIGHTS CONNECTED IN PARALLEL.

THE INDUSTRY

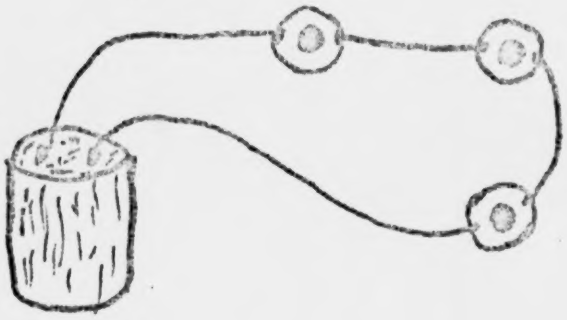
A SIMPLE SERIES CIRCUIT

OBJECTIVE: Given this lesson, you will connect a simple series circuit.

ACTIVITY: Get the following materials:

Bell wire
1½ volt dry cell
3 light bulbs
3 sockets

Connect the circuit drawn below.



NOTE: In a series circuit, there is only one path through which electrons can flow. This path is the wire connected to the two terminals of the power source. The lights are connected into this wire one after the other as shown above. If the circuit is broken at any point, the flow of electrons stops. All of the bulbs in a series connected group of lights go out.

Generally, Christmas tree lights are series connected.

FOR THE STUDENT

THE INDUSTRY

SOME BASIC ELECTRICAL PRINCIPLES

OBJECTIVE: Given this lesson, you will state 5 basic electrical principles.

ACTIVITY: STUDY THE MATERIAL BELOW.

1. A current of electricity is a flow of electrons through a wire.

2. There must be a complete circuit to have a flow of electricity.

3. When electricity flows through a wire, a magnetic field of force is created around it. This magnetic field travels in a circular pattern forming a magnetic cylinder the full length of the wire.

4. If several loops of wire are shaped in the form of the coil, the magnetic effect is greatly increased.

5. With two coils the electric energy can be transferred from one circuit to the other through a magnetic coupling. This transfer of energy is called mutual induction..

POST TEST: State 5 basic electrical principles.

STUDENT PACKAGE

No. B-180

THE INDUSTRY

STATES OF ENERGY - POTENTIAL AND KINETIC

Objective:

Given a rubber band and a hammer, you will demonstrate and tell what is meant by potential energy, and what is meant by kinetic energy.

Activity:

1. Get a rubber band.
2. Get a hammer, a nail, and a piece of scrap stock.

Potential energy is the energy of position.

If you stretch a rubber band between your fingers, it represents potential energy.

A hammer on a bench ready for use represents potential energy.

Snap the rubber band back and forth and the potential energy is changed to kinetic energy.

If you lift the hammer and drive a nail into some stock, the hammer's potential energy is changed to kinetic energy.

Kinetic energy is the energy of movement.

Energy is constantly changing from the potential to the kinetic state and back again.

Post test:

In your own words describe potential energy and kinetic energy to your shop foreman.

THE INDUSTRY

TYPES OF CURRENT - DIRECT AND ALTERNATING

OBJECTIVE: Given study material, you will be able to describe direct current and alternating current.

ACTIVITY: STUDY MATERIAL BELOW.

All electrical current does not flow continuously in the same direction.

DIRECT CURRENT flows continuously in the same direction until the circuit is broken or the power fails. The amount of direct current may vary, but its direction does not vary.

Examples that use direct current: street cars, arc welders, electroplators.

ALTERNATING CURRENT changes the direction of its flow at periodic intervals called cycles. A cycle is one complete reversal of current. The frequency of an alternating current is the number of cycles in a second. If complete reversals occur each second, the electric current involved is referred to as a 60-cycle alternating current.

Examples that use alternating current: clocks, radios, washing machines and most household appliances.

POST TEST: Name 2 objects that use direct current.
Name 2 objects that use alternating current.

TEACHER PACKAGE

ORGANIZATION AND MANAGEMENT

THE DEFINITION OF ORGANIZATION

Objective

Given the four characteristics of organization, the student will be able to write at least one of these four characteristics.

Activities:

1. The teacher will discuss organization. Recommended information to be used.

Definition of Organization

No human group activity is ever successful unless it is "organized." Only rarely do people achieve satisfactory results without first having organized their thoughts or developed an organized method of approach before tackling a problem or task. It is with this thought in mind that we look at the subject of organization in a manufacturing concern. The effort of every person in a manufacturing concern must be related to the common purpose and to the efforts of all persons in the enterprise.

As applied to the efforts of two or more people, "organization" has been defined in a number of different ways. For example, it has been called a system of communication, a means of problem solving, and a means of facilitating decision-making. Organization has been viewed as a social system, and as systems in the cybernetic sense of a group interacting variables.

An organization is all these things. But for practical purposes, organization can be defined simply as a process of (1) determining what must be done if a given aim is to be achieved, (2) dividing the necessary activities into segments small enough to be performed by one person; and (3) providing means of coordination, so that there is no wasted effort and the members of the organization do not get in each other's way.

2. Have the students organize themselves into four groups, vote on a leader for their group, discuss one of the four characteristics of organization on the handout sheet, and return to the class with a brief explanation to be presented to the class by the leader. Emphasis should place on the organization of their groups.

3. Pass out the handout sheets to the students.

Post-test

Write at least one of the characteristics of organization.

HANDOUT SHEET

Organization planning is the process of defining and grouping the activities of an enterprise so they may be most logically assigned and effectively executed. It is concerned with the establishment of relationships among the units so as to further the objectives of the enterprise.

Characteristics of the organization:

1. Organization is a planning process. It is concerned with setting up, developing, and maintaining a structure or pattern of working relationships for the people within the enterprise. It is carried on continuously as changes in events, personalities, and environment require. Thus, organization is dynamic.

2. Organization is the determination and assignment of duties to people to obtain the advantages of fixing responsibility and specialization through subdivision of work.

3. Organization is a plan for integrating or coordinating most effectively the activities of each part of the enterprise so that proper relationships are established and maintained among the different work units and so that the total effort of all people in the enterprise will help accomplish its objective.

4. Organization is a means to an end. Good organization should be one of the tools of accomplishing the company's objectives, but it should not become an objective in itself.

TEACHER PACKAGE

ORGANIZATION AND MANAGEMENT

GRAPHICAL VIEW OF ORGANIZATION

Objective:

The student will describe the formation of a corporation by listing the prime functions of each of the following:

1. Stockholders or owners
2. President
3. Board of directors
4. Five major subdivisions

Activity:

Introduction of materials to students. Initiate a discussion among the students, talk about companies, local department stores, etc. Point out the importance of each division of the chart and how one depends upon the other. Aid in keeping the discussion in the right direction. Teacher will have on hand a brief summary of the duties of each division to be used only if the student needs help. Have pupils relate their experience on any part of the chart he desires. Pupils will be asked to suggest means by which the class may obtain and share information with each other in the class. After the discussion, pupils will be asked to review his list. This can be done by using the source material posted by the teacher for pupil research.

Post test:

1. List three duties of the president.
2. What is the function of the board of directors?
3. Name five of the divisions given in the flow chart.
4. Define research and development.

Part of the media for a Graphical View of Organization includes a description of a selected division of the corporation. The description herein have been limited in detail to be sufficiently general for discussing areas of responsibility and activity.

Note: Transparency may be made from the attached master showing flow chart.

Stockholders - The stockholders are the owners of the company. They have invested their money to buy stock. Their job is to elect a board of directors. The directors then appoint the president.

President - The duties are: schedule regular staff meetings to facilitate smooth operation of the company. Schedule all meetings that are required by the various departments in the company organization. Develop a calendar schedule which will include such activities as staff meetings, department meetings, production runs and special programs.

Clerical - Develop and construct a personnel organizational chart. Hire, assign and reassign workers to specific jobs as it is deemed necessary. Develop forms and records that will be useful in carrying out the duties of that division.

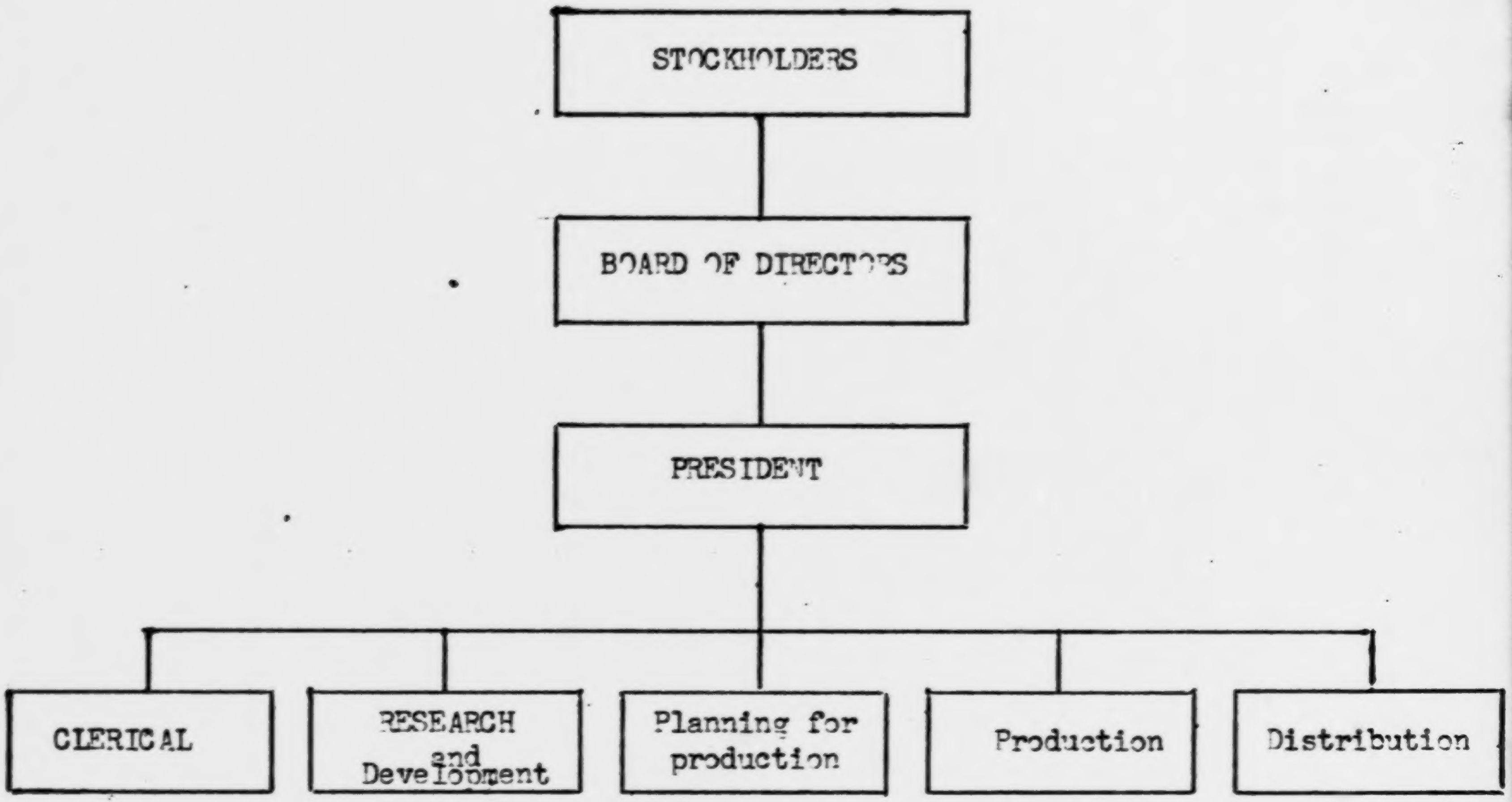
Research and Development - This is a highly organized function of industry devoted to the seeking out and development of profitable and useful goods. Research and Development have two basic functions, to discover new materials and principles as they relate to the purpose of the company, and secondly to apply these discoveries in such a way that they will be of value in terms of commercial importance.

Planning for Production - The actual working system of an industry. It begins with the visualization of an idea and develops all the necessary layout of men, material, machines, and processes needed to produce a specific product. It transforms information into drawings and specifications. Other functions are estimating, procurement of materials, inventory, and the development of routings are made possible.

Production - In this stage, the product is ready to be produced or manufactured. Men, machines, and materials are brought together according to a plan to create or produce the product to the satisfaction of the consumer.

Distribution - Develop an advertizing campaign to stimulate a demand for the company product. Carry out the marketing of the product by packaging, determining the products's appearance and construction.

MANAGEMENT


STOCKHOLDERS
BOARD OF DIRECTORS
PRESIDENT
CLERICAL
RESEARCH and Development
Planning for production
Production
Distribution

Flow chart showing the organization of a manufacturing industry showing major subdivisions only.

Transparency for the overhead projector will be made from this master.

FOR THE TEACHER

No. C-3

ORGANIZATION AND MANAGEMENT

KINDS OF OWNERSHIPS

Objective:

Given three basic kinds of ownerships the student will write the distinction between each, and give an example of each.

Activities:

1. Students will define the following and give an example of each.
    a. Proprietorship
    b. Partnership
    c. Corporation
2. Students will give an example of one company to illustrate each type of ownership.

Post test:

1. Define the following
    a. Proprietorship
    b. Partnership
    c. Corporation

PROPRIETORSHIP:

Ownership of a business by a single individual. It is the simplest and oldest type of ownership. Such business includes many small producers of goods, farmers, people engaged in service and trade, and many professional establishments.

PARTNERSHIP:

Means the ownership of a business by two or more persons who share in financing and/or operation in a manner which may be classed as multiple proprietorship. A partnership may result when two or more individuals agree to pool their interest and efforts in an enterprise. The capital contributed and the operating responsibility agreed upon can be equal or unequal. Such agreements may be by verbal or written contract.

CORPORATION:

The dominant form of ownership in manufacturing in the United States is the corporation. Although sole proprietors and partnerships are numerically great, corporations handle most of the manufacturing when measured by assets, employment, and sales. All of our large industries are corporations. The corporation is treated in the legal sense as an individual, apart from the owners and managers. It exists by charter granted by a State in accordance with the laws of that State. It exists as a legal entity without regard to changes in ownership or management. Contracts, business transactions, financial accounts, profits and losses, employment responsibilities, and the like are charged to the corporate body, not to the individual participants.

FOR THE STUDENT

No. C-4

MANAGEMENT

PREPARING A STOCK CERTIFICATE

Objective:

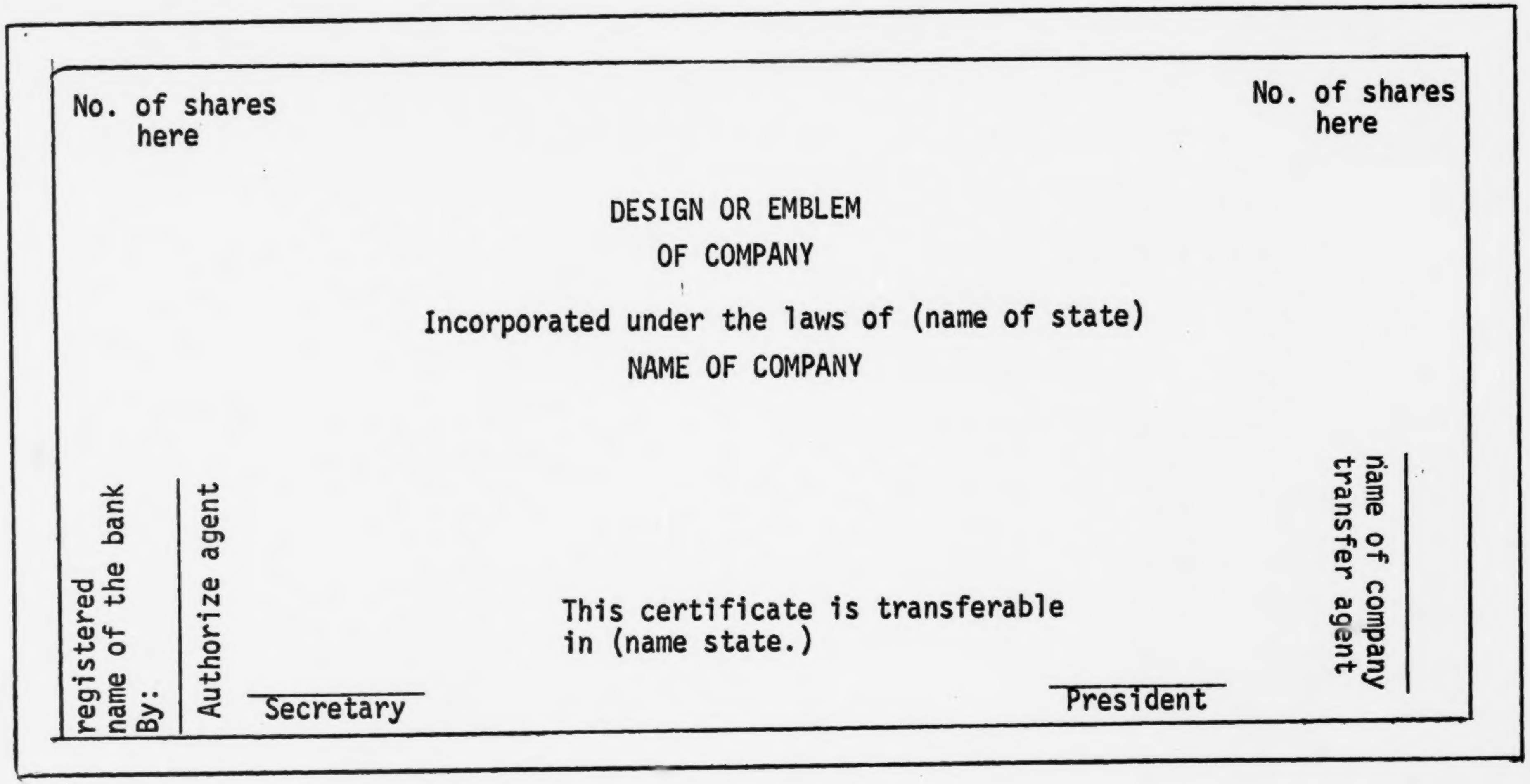
Given a rough sketch of a stock certificate, plus any needed information, you will design a stock certificate for your company. Your stock must agree with the sample in content only. The design may vary to suit your needs.

Activity:

Look at page two of this package and examine the model stock certificate. You will need pencil, paper, and a ruler.

1. Including all items listed below, design at least two models of a stock certificate, from which the class will select the best one.
   - A. Name of the company and state of incorporation.
   - B. Serial number of certificate.
   - C. Number of shares represented.
   - D. In case of par stock, the par value.
   - E. Name of the registered owner.
   - F. Date of issue.
   - G. Signature of appropriate corporate officer.
   - H. Seal of the corporation.
   - I. Signature of the transfer agent and registrar.
2. Examine what you have done.
3. Return to the teacher for his evaluation of your certificate(s)

A SAMPLE STOCK CERTIFICATE



No. of shares here

No. of shares here

DESIGN OR EMBLEM
OF COMPANY

Incorporated under the laws of (name of state)
NAME OF COMPANY

registered
name of the bank
By:

Authorize agent

Secretary

This certificate is transferable
in (name state.)

President

name of company
transfer agent

TEACHERS' REFERENCE INFORMATION FOR STUDENT PACKAGE No. C-4

1. No time limitation is stated in the objective because the sketch of the certificate may vary in complexity, which, in turn, will determine the time required to make the model.

2. You should have on hand several copies of stock certificates. The student may look at the actual certificates and get ideas for his model.

3. The following is important information which relates to stock certificates:

> In the United States, though not in all foreign countries, corporations usually issue stock certificates which are used as evidence of ownership. One reason for the use of stock certificates is that they greatly facilitate the mechanical and clerical work involved in the purchase and sale of stock on the exchange. However, the certificate is not the stock but only the evidence of its ownership, and a person who owns stock is entitled to all of the rights and privileges of voting.

FOR THE TEACHER

No. C-4

ORGANIZATION AND MANAGEMENT

DISTRIBUTION OF FUNCTIONS WITHIN A TYPICAL GROCERY STORE

Objectives:

Given an organization chart of a typical grocery store and its functions, the students will assign the specific functions to the various positions within the store.

Activities:

Recommended information to be used by the teacher.

1. Discuss that all business enterprises must determine their objectives. No matter how small the business may be, the organization structure must be properly utilized if the company is to survive and prosper. Therefore, the objectives are to be formulated, and the responsibilities allocated, even if the organization consists of only one man.

   The allocation of responsibilities becomes more important when there is more than one person in the organization. Usually those responsibilities which are not assigned are likely to be neglected. Specific assignment of responsibilities also assures that they will be placed with those who can exercise them best.

   After deciding on location, types of customers, and merchandise, one must determine sales potentials, prospective revenues, and costs.

   These factors influence the number and type of functions that must be exercised. Assume that the owner of a store decides that he needs a salesman and deliveryman in order to meet the objectives.

2. Issue handout sheets, numbered 1 & 2, showing the organizational structure of a grocery store, and its functions.

3. The students will read the functions, and allocate the functions to the specific workers.

4. Enclosed is a transparency to show how the specific functions should have been allocated.

HANDOUT SHEET #1 - Specific Functions

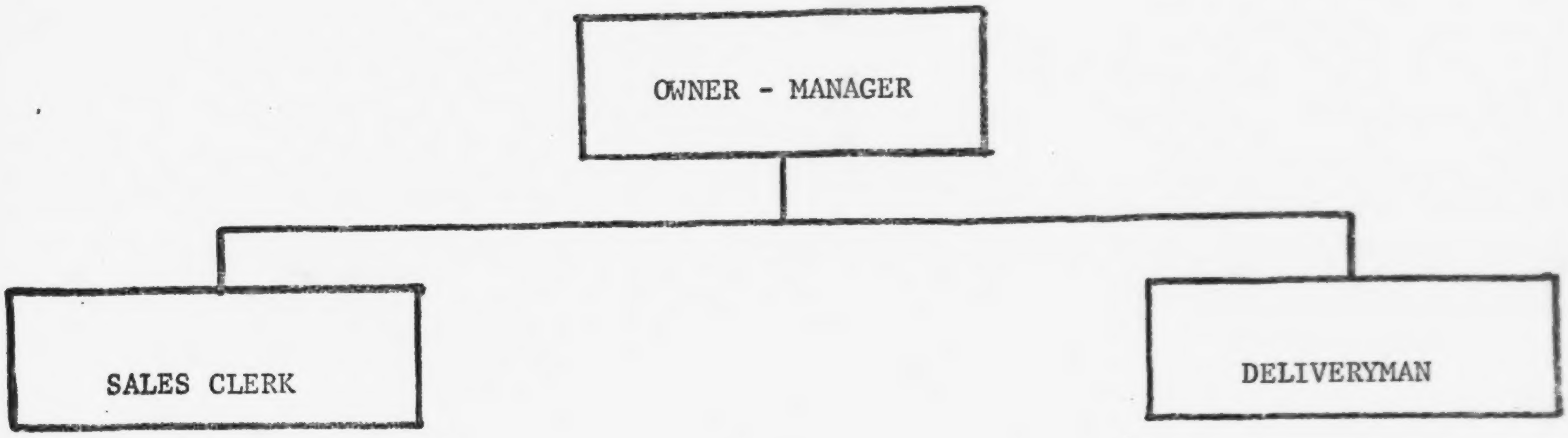
To be assigned in the proper space under the organization chart.

1. Deliver orders
2. Answer phone
3. Pay bills
4. Keep records
5. Check on inventory
6. Keep store clean
7. Supervise selling and sell
8. Get prices and discounts
9. Sell merchandise
10. Open and close store
11. Arrange window displays
12. Handle bank accounts
13. Handle taxes
14. Make contracts
15. Handle complaints
16. Control expenses
17. Order merchandise
18. Control slow-moving inventory and stock shortages

HANDOUT SHEET #2

This is an organization chart of a small grocery store

A TYPICAL GROCERY STORE

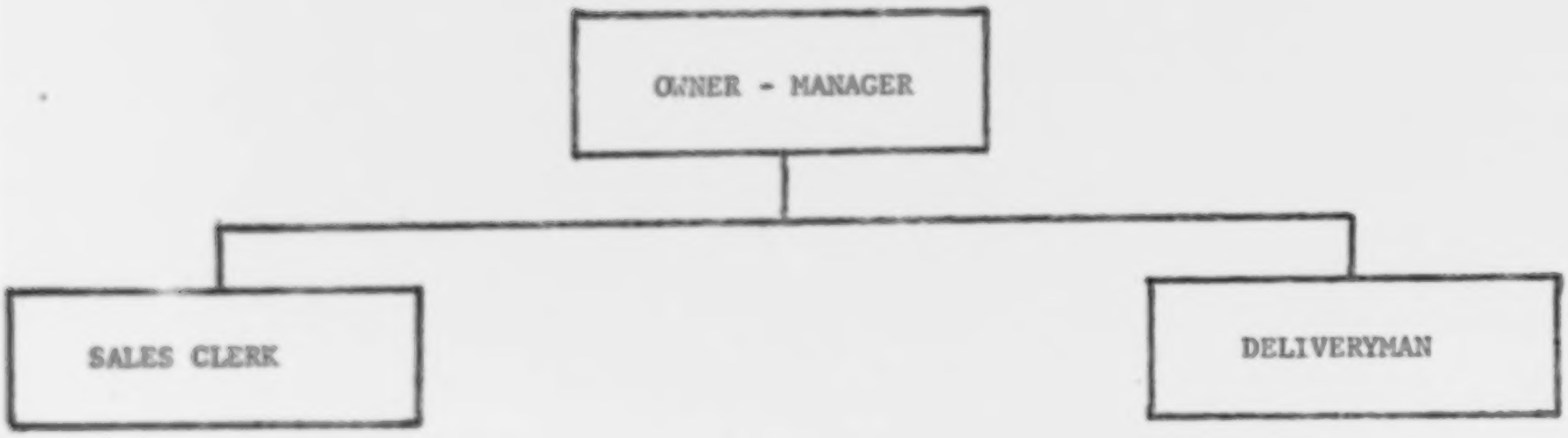

OWNER - MANAGER
SALES CLERK
DELIVERYMAN

OWNER-MANAGER	SALES CLERK	DELIVERYMAN

For The Teacher

This is a transparency showing the specific functions assigned properly

A TYPICAL GROCERY STORE



OWNER - MANAGER	SALES CLERK	DELIVERYMAN
Order merchandise	Sell merchandise	Deliver orders
Control slow-moving inventory and stock shortages	Answer phone	Open and close store
Get prices and discounts	Check on inventory	Keep store clean
Supervise selling and sell	Arrange window displays	
Arrange advertising		
Pay bills		
Control expenses		
Keep records		
Handle bank accounts		
Handle taxes		
Make contracts		
Handle complaints		

FOR THE TEACHER

ORGANIZATION AND MANAGEMENT

FINANCING THROUGH SALE OF STOCKS

Objective:

The student will be able to write the names of two kinds of stock, and briefly explain the nature of each.

Activity:

1. Have pupils discuss the way by which companies secure funds for financing a business.
2. Teacher will list the following means of financing a business:
   a. Small business or partnership investing their own money.
   b. Companies may borrow from banks or financial institutions.
   c. Sell stocks for needed finance.
3. Class will examine each of the listed means of finance.

Post test:

1. Define the following:
   a. Common stock
   b. Preferred stock
   c. Stocks
2. Briefly explain why a company would sell stock.

STUDENT HANDOUT

No. C-5

One major function of the finance department in a corporation is to raise funds to run the business. Small businesses or partnerships may invest their own money or may borrow from friends, banks, or the federal government. Most businesses, however, are organized as corporations which have the legal right to sell stocks, bonds, and debentures to raise money to carry on the process of making goods or performing a service. Companies may also borrow from banks, insurance companies, or other financial institutions for short periods of time.

Capital stock has been defined as the stock or share certificates showing ownership, which have been (or may be) sold for cash to provide the the property necessary for the operation of the business.

Stocks are of two kinds: common and preferred. Preferred stocks usually yield a fixed rate of income. Holders of preferred stock are paid before any profits are divided among common stockholders. Common stocks yield variable rates of income. When companies make a high profit, the income from common stocks is usually good. Investors in common stock have chances of making money through growth in value and annual income; and they vote for members of a company's board of directors, thus giving them a voice in the management of the company.

TEACHER PACKAGE

No. C-6

ORGANIZATION AND MANAGEMENT

SUGGESTED FINANCING

Objective:

At the completion of this package, the students will be able to:

1. Name five means of raising funds for a business.
2. Expalin the difference in the financial structure of small and large business.

Activity:

Using the hand-out sheet on the next page, the teacher and students should discuss the need for finance.

Points to include:

1. Which department in a company is responsible for raising funds.
2. What is the difference in the financial structure of a small business and a large corporation?
3. Where can a businessman look for needed funds in getting a business started, and in sustaining that business?

Post test:

1. Name five ways by which a company may get needed funds for starting a business.
2. What is the main source of funds in a small business?
3. What advantage does the coporation have over a small business in raising funds?

One major function of the finance department is to raise funds to run the business or manufacturing venture.

Suggestion:

1. Small businesses or partnerships may invest their own money or may borrow from friends, banks, or the federal government. It may be difficult for a small business to borrow money. People want to be sure that their money will return interest.
2. Most businesses are organized as corporations which have the legal right to sell stock, bonds, and debentures to raise money to carry on the process of making goods or performing a service.
3. Some corporations have millions of stockholders, who have provided long-term financing.
4. Companies may also borrow from banks, insurance companies, or other financial institutions for short periods of time.
5. Financial departments may arrange for credits (deferment of payment) from suppliers until profits from the sale of products can pay the bill.

NOTE:

Bonds sold by companies take precedence over all other assets of a corporation. The finance department could be compared to a tree with roots and branches reaching into every part of a business or industrial plant.

TEACHER PACKAGE

No. C-7

ORGANIZATION AND MANAGEMENT

SURPLUS AND DIVIDEND POLICIES

Objective:

After studying this instructional unit, the student will be able to:

1. Define surplus
2. Name five out of six basic requirements for declaring a dividend.
3. Give the legal rule governing payment of dividend.

Activity:

The law in this country states that dividends cannot be paid if capital has been impaired. Impaired capital means that the company still owes money and profits will not allow dividends.

The term surplus may be defined as an excess of assets over liabilities, which results in money left over after all expenses are paid.

The following are points of consideration before a dividend can be declared.

1. An examination of the company to determine if a dividend can be legally declared.
2. An examination of the sources of the surplus to see if the dividend can be declared from the standpoint of expediency.
3. Is the cash position of the company such to justify a distribution of cash at the present time.
4. What are the future prospects of the business itself.
5. If a cash dividend cannot be paid,some distribution should be made to satisfy the equities between present and future owner.
6. Where earnings are unusally large, a stock dividend may be used as a step in the readjustment of the capitalization.

A dividend may be necessary to protect the interest of old stockholders when a company is about to sell a new issue of stock.

A final aim of a corporation should be the declaration of dividends at a fairly stable rate year in and year out. Stockholders, of course, have the right to expect that as prices of all commodities and services increase, their income also will increase. A stable dividend policy, therefore, does not mean an inflexible policy, but one that involves the payment of a fair rate of return, taking into consideration the graduate growth of the business and the graduate evolution of external events.

Post test:

1. Write on a sheet of paper at least five considerations that a board of directors would take before declaring dividend for that year.

2. Define surplus.

3. Comment on the statement. "A company may declare a dividend any time it pleases."

FOR THE TEACHER

ORGANIZATION AND MANAGEMENT

GRAPHICAL VIEW OF ADMINISTRATION

Objective:

After studying the administrative chart authority, the student will be able to:

1. Define Organization and Management.
2. Name eight major divisions found in administration.

Activity: (Teacher presentation)

Have students refer back to package C-2, which represents the total graphical view of industry. This package (C-8) examines one section from package C-2, and enlarges it. It is provided to give a more detailed example of the graphical view of one part of an organization. It illustrates how industry breaks down a division, and improves the function of that division.

Administration is the team that guides the affairs of the business. It may include:

1. Board of directors
2. Company officials
3. General management
4. Heads of the major operating divisions.

Administration may be defined as that activity of management which fulfills or carries out the objectives, or goals, for which the organization, or project is established.

The role of top administration in industry is to assemble the means and to direct the activities necessary for the manufacture and distribution of products. Top level administration functions can be classified as forms of co-ordination and control. A systematic approach may include:

1. Organizational analysis and planning.
2. Preparation of a replacement in each executive position.
3. Appraisals of executive performance.
4. Planned programs for guiding individuals into executive development.

NOTE: The teacher may make a transparency from the chart.
Pupils and teacher will study each of the eight divisions.
Pay particular attention to subdivisions.

POST TEST

Name______________________________

A. Division of joint control
B. Division of health and safety
C. Division of education
D. Division of research
E. Division of employment
F. Division of employment service
G. Advisory personnel committee
H. Board of personnel directors.

Match the description which follows with the correct division of Administration listed above by placing the correct letter in the blank.

1. Personnel administrator, employment director, doctor, safety engineer educational director, service director, and representatives of workers.

______________.

2. Interviewers, selectors, field agents, messengers, etc.

______________.

3. Production manager, Foreman's representative, and workers' representative.

______________.

4. Plant instructors, inspectors, outside expert, librarian.

______________.

5. Job analysts, time and motion study experts, fatigue experts.

______________.

6. Dietitian, matron, athletic director, music director.

______________.

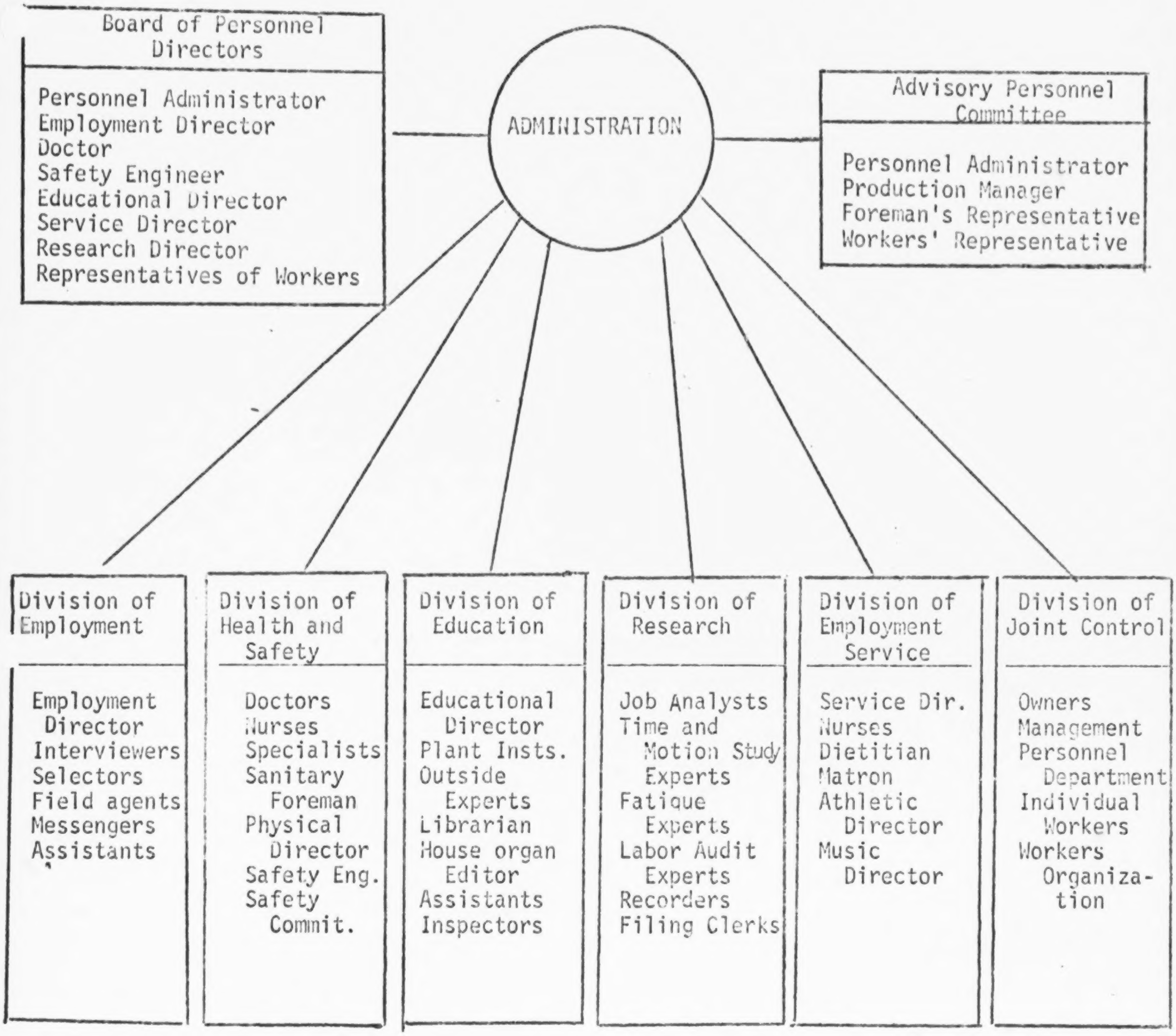
7. Owners, management, personnel department, individual workers.

______________.

8. Nurses, specialists, sanitary foreman and physical director.

______________.

Note to teacher: To be used with overhead projector following discussion


Board of Personnel Directors
Personnel Administrator
Employment Director
Doctor
Safety Engineer
Educational Director
Service Director
Research Director
Representatives of Workers
ADMINISTRATION
Advisory Personnel Committee
Personnel Administrator
Production Manager
Foreman's Representative
Workers' Representative
Division of Employment
Employment Director
Interviewers
Selectors
Field agents
Messengers
Assistants
Division of Health and Safety
Doctors
Nurses
Specialists
Sanitary Foreman
Physical Director
Safety Eng.
Safety Commit.
Division of Education
Educational Director
Plant Insts.
Outside Experts
Librarian
House organ Editor
Assistants
Inspectors
Division of Research
Job Analysts
Time and Motion Study Experts
Fatique Experts
Labor Audit Experts
Recorders
Filing Clerks
Division of Employment Service
Service Dir.
Nurses
Dietitian
Matron
Athletic Director
Music Director
Division of Joint Control
Owners
Management
Personnel Department
Individual Workers
Workers Organization

ADMINISTRATION

CHART AUTHORITY

ORGANIZATION AND MANAGEMENT

LINE AND STAFF DISTINCTION

Objective:

Given a discussion of line and staff functions, the student will write a brief description of the duties of line and staff members.

Activity:

This package further demonstrates the need and importance of communication and organization in industry. In industry for each task, function, or other grouping of activities there is an appropriate authority. This package will examine two types, line and staff authority.

1. The entire class should have an opportunity to review very carefully line and staff duties. (See handout sheet found in this lesson).
2. Students, using the information given in the handout sheet, will design a line and staff organization chart.
3. Basic considerations the students will consider in designing this chart will be:
    - a. How much authority would the chief engineer have?
    - b. Would the sales manager make all decisions in regard to sales?
    - c. What is the amount of authority given to the foreman?
    - d. Others.
4. Students and teacher will work out details in the organizational chart and use it in the class enterprise.

STUDENT HANDOUT

Line authority is the basic and fundamental authority in an organization. It is the ultimate authority to command, act, or decide in matters affecting others. It is the authority which sanctions or approves, directly or indirectly, the activities which take place in the organization. It is the authority to channel and direct the responses of others and to require them to conform to decisions, plans, policies, systems procedures, and goals. It is the heart of the relationship between employee and his supervisor.

Line authority is not merely the right to decide but rather to command. This a delegated position by the executive, usually the president. There are three purposes of line authority:

1. It provides the basic decisions involved in operation in an enterprise. It makes the leadership process effective by establishing channels of communication.
2. It serves as a means of control by setting limits to the scope of authority of individuals. It helps to assure that employees conform to the plans and policies of the enterprise.
3. A third purpose of line authority is to provide points of reference for the sanctioning and approval of proposals or actions.

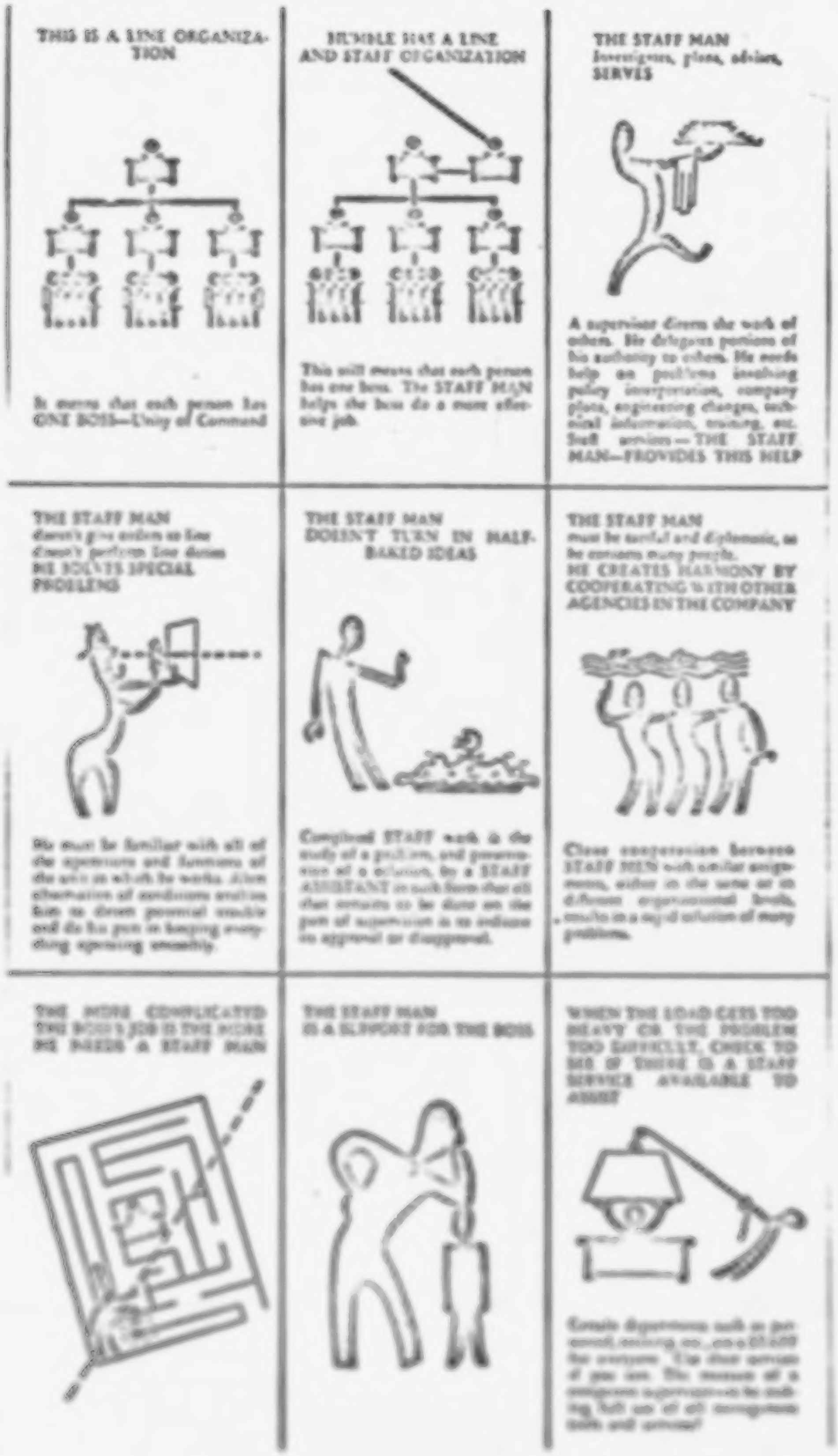
Staff authority is best defined as authority whose scope is limited by the absence of the right to command, to auxiliary and facilitating activities such as planning, recommending, advising, or assisting.

Staff authority is the result of problems which face executive in an organization as it achieves increasing size and complexity. Line authority alone becomes inadequate for large-scale organizations. The most outstanding characteristic of staff authority is the absense of the right to command. The staff executive cannot command others outside the realm of his own department, although he has a line relationship to the members of his own department and can exercise command authority over them.

Post test:

1. In your own words distinguish between line and staff functions.
2. Is there a signficant difference as to the function between line and staff?
3. Would it be correct to say simply that both line and staff are striving to successfully meet the objectives of the firm? Explain.

LINE AND STAFF ORGANIZATION



THIS IS A LINE ORGANIZATION

It means that each person has ONE BOSS—Unity of Command

HUMBLE HAS A LINE AND STAFF ORGANIZATION

This still means that each person has one boss. The STAFF MAN helps the boss do a more effective job.

THE STAFF MAN
Investigates, plans, advises,
SERVES

A supervisor directs the work of others. He delegates portions of his authority to others. He needs help on problems involving policy interpretation, company plans, engineering changes, technical information, training, etc. Staff services — THE STAFF MAN—PROVIDES THIS HELP

THE STAFF MAN
doesn't give orders to line
doesn't perform line duties
HE SOLVES SPECIAL PROBLEMS

He must be familiar with all of the operations and functions of the unit in which he works. Alert observation of conditions enables him to detect potential trouble and do his part in keeping everything operating smoothly.

THE STAFF MAN DOESN'T TURN IN HALF-BAKED IDEAS

Completed STAFF work is the study of a problem, and presentation of a solution, by a STAFF ASSISTANT in such form that all that remains to be done on the part of supervision is to indicate its approval or disapproval.

THE STAFF MAN
must be tactful and diplomatic, as he contacts many people.
HE CREATES HARMONY BY COOPERATING WITH OTHER AGENCIES IN THE COMPANY

Close cooperation between STAFF MEN with similar assignments, either in the same or in different organizational levels, results in a rapid solution of many problems.

THE MORE COMPLICATED THE BOSS'S JOB IS THE MORE HE NEEDS A STAFF MAN

THE STAFF MAN IS A SUPPORT FOR THE BOSS

WHEN THE LOAD GETS TOO HEAVY OR THE PROBLEM TOO DIFFICULT, CHECK TO SEE IF THERE IS A STAFF SERVICE AVAILABLE TO ASSIST

Certain departments such as personnel, training, etc., are a STAFF for everyone. Use their services if you can. The measure of a competent supervisor [illegible] all competent [illegible]

COMPARISON OF LINE AND STAFF CHARACTERISTICS AS APPLIED IN INDUSTRY.

FOR THE TEACHER

ORGANIZATION AND MANAGEMENT

DELEGATING AUTHORITY AND RESPONSIBILITY

Objective:

After studying this lesson the student will be able to:

1. Define authority
2. Describe the delegation process
3. Outline three delegating processes

Activity:

This package will examine the nature of the delegation process and the conditions under which the delegation of authority may best be carried out. This is one of the most vital organization processes.

In an enterprise, the authority to run a business lies primarily with the chief executive, who is usually the president.

We may define delegation itself as that part of the organizing process by which an executive, administrator, or manager makes it possible for others to share in the work of carrying out the company's purpose.

The delegation process is the means by which authority is distributed throughout the organization. The distribution of authority throughout a business does not occur automatically. It is the deliberate design or plan by which a leader makes his authority effective and influential.

Three basic steps in delegating authority:

1. Assignment of duties by an executive to his immediate subordinates.

2. Granting of permission (authority) to make commitments, use resources, and take over necessary actions.

3. Creation of an obligation (responsibility) on the part of each subordinate to the executive for satisfactory performance of the duties.

The delegating executive can employ a number of techniques and procedures to help achieve the goal of sufficient clarity of authority. Organization charts and manuals help to provide specific points of reference for maintaining such arrangements of authority relationships as required by current problems and needs, as well as for future planning.

STUDENT ACTIVITY

Activity:

1. After discussing the first and second sheet of this lesson, the students should develop a system the class may use in the management process.
2. A student should list, all suggestions on the board.
3. After the suggestions, student may now discuss each and compare it with the guidelines found on page one and two of this lesson.
4. Now students will begin to select the ones they think are important for their class.
5. A permanent record will be made of the procedure to be followed in the future.

Post test:

A. Using your words formulate a definition of delegated authority.

____

____

____

B. Give three basic steps in delegating authority.

____

____

____

C. Describe the steps you would take to make sure that the authority you are delegating to others is clear.

____

____

____

TEACHER PACKAGE

No. C-11

ORGANIZATION AND MANAGEMENT

SELECTING EXECUTIVE TALENT

Objective:

The student will list four qualities essential for an executive, and three processes used in selecting this individual.

Activity:

1. Discuss with the student the following qualities essential for an executive. (See Page 3 for added information on these qualities.)
    a. Leadership
    b. Communication
    c. Intellectual and conceptual ability
    d. Administration skills
2. The selection process includes:
    a. The collection of information and data through interviewing, observation, references, application blanks and tests.
    b. Analysis of the data and decision-making as to acceptability for employment.
    c. Actual placement and follow-up procedures.
3. On Page 2 is a hand out sheet containing an explanation of the selection process. Have pupils read this material carefully.

Post test:

1. List four qualities which are considered essential for and executive.

2. List three factors in the selection process.

3. Do you consider any one factor among the traits more important than another? Explain.

HAND OUT SHEET

Personnel men have developed a technique for selecting and placing all kinds of employees. Scientific selection procedures have been more extensively applied for hourly factory workers and office-clerical job categories than for executive jobs. Many executives have risen through the ranks, without having such systematic procedures applied to them.

At the point where a particular executive has resigned or has otherwise been separated from employment with the company, and opportunity arises to consider whether or not to obtain a replacement , and if so, whether to seek one who is nearly as possible the exact duplicate of the departing executive. The point of replacement is a crucial decision, because it could mean building a dynamic rather than static organization.

Data collecting: It is important to get a complete and comprehensive picture of the applicant. No single system has been developed to achieve this end. Some procedures have been more effective than others in helping a company decide the best course of action.

Observation: Some executives have the capacity for systematic and careful observation. Those having a part in selecting executives should be trained in systematic observation. Observation has its limitations, in that it may not reveal all character, personality, or specific abilities.

Application blanks: The purpose of application blanks are to provide basic data such as name, age, and work experience for the permanent record if the man is hired. It also acts as a starting point for investigations which follow.

Interviewing: Scarcely any executive is hired without one or more interviews, frequently as many as six or eight. The interview serves as a checking point on the accuracy of the application blank. It also provides a means to inquire about information not suitable for application. Interviews range from matter-of-fact question and answer sessions to highly complicated in-depth interviewing by trained psychologists, seeking reaction patterns and personality characteristics.

Tests: Tests can reveal information that is available in no other way. Such tests include measures of intelligence, motor skills such as dexterity, spatial relations, mechanical aptitudes, and other aspects of human behavior.

QUALITIES ESSENTIAL FOR EXECUTIVES

Leadership:

1. This person must be able to specify clearly the goals of the organization.
2. As a leader, his task would be to blend the abilities of the individuals working for him.
3. As a leader, he has the responsibility of pointing out which objectives are primary and which are secondary.

Communication:

The working day of every executive is crammed with communication of many kinds. This person should be able to give orders, directions, informative conversation, requests, reports, etc.

Intellectual and conceptual ability:

1. Generally knowledgeable and functional in effectively working with a group.
2. Has analytical ability.
3. Conceptual skill--this means the ability to see the enterprise as a whole. It means visualizing the relationship of the individual business to the industry, the community, political and social forces.

Administrative skills:

1. This is the ability to deal effectively with making clear and stable policies.
2. To be able to make policies and procedures which will dovetail and contribute to the major objectives of the company.
3. Administrative skills reflect the abilities of leadership in terms of:
    a. Additional capital through sale of stocks or bonds.
    b. Reaction to labor unions.
    c. Important decision making and determining significant policy issues.

FOR THE TEACHER

ORGANIZATION AND MANAGEMENT

DUTIES AND RESPONSIBILITIES OF PERSONNEL ADMINISTRATOR

Objective:

The student will list 5 major duties and responsibilities of a personnel administrator.

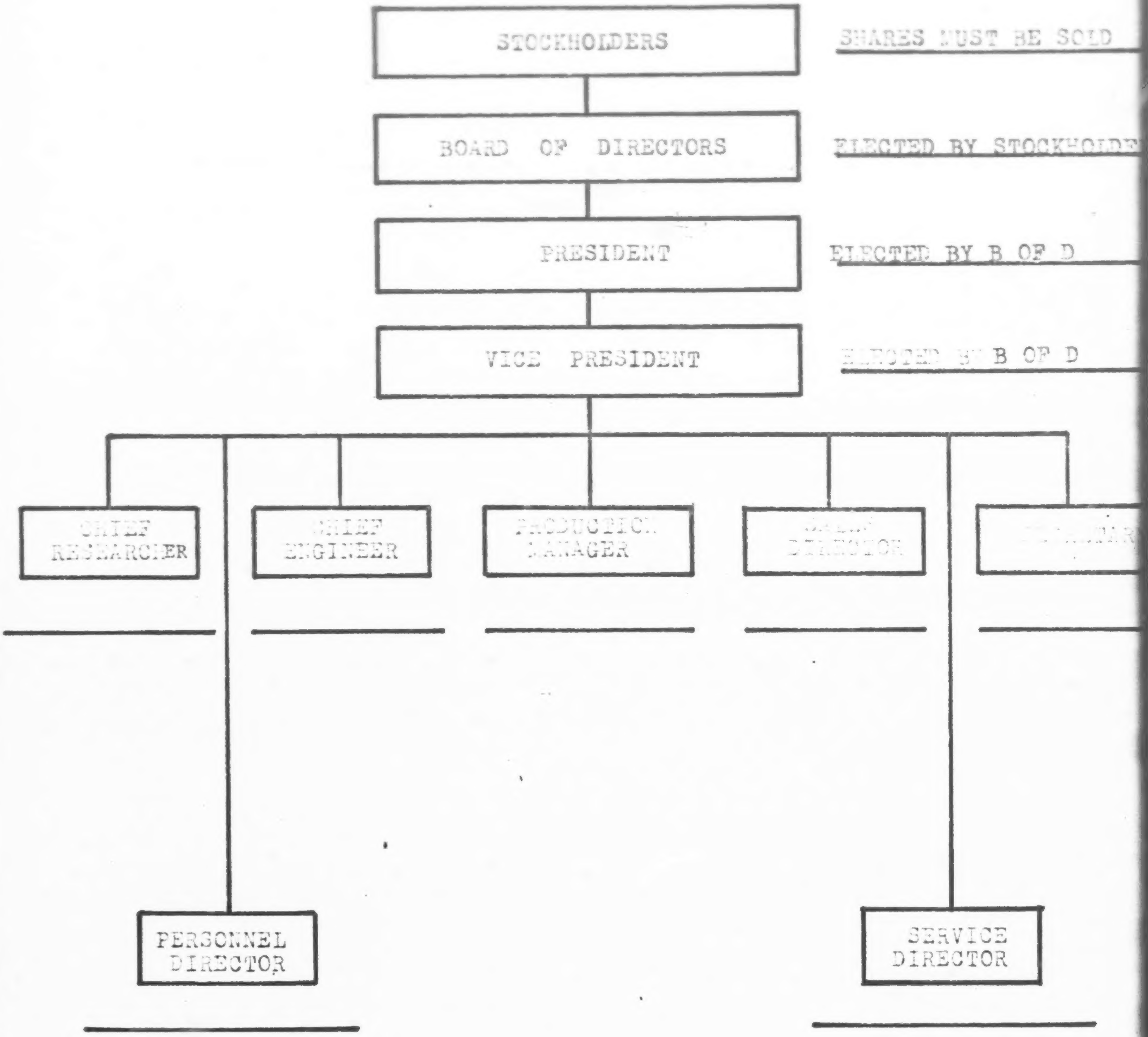
Activity:

Have students refer back to Package C-8, which represents the total graphical view of administration. This package (C-13) examines one section dealing with the personnel administrator.

1. Discuss with the students the following things expected of the personnel administrator.
   a. Recruitment process
   b. Selection procedure for employees
   c. Job placement
   d. Training programs
   e. Methods to be used in promotion
   f. Wage payment
   g. Benefits and service
   h. Health and safety
2. Have students select from the above list the divisions they would like to have in their enterprise.

Post test:

The post test will serve two purposes. First, it will give each student a chance to decide what he thinks is important for the class enterprise. Second, it will serve as a means for the class

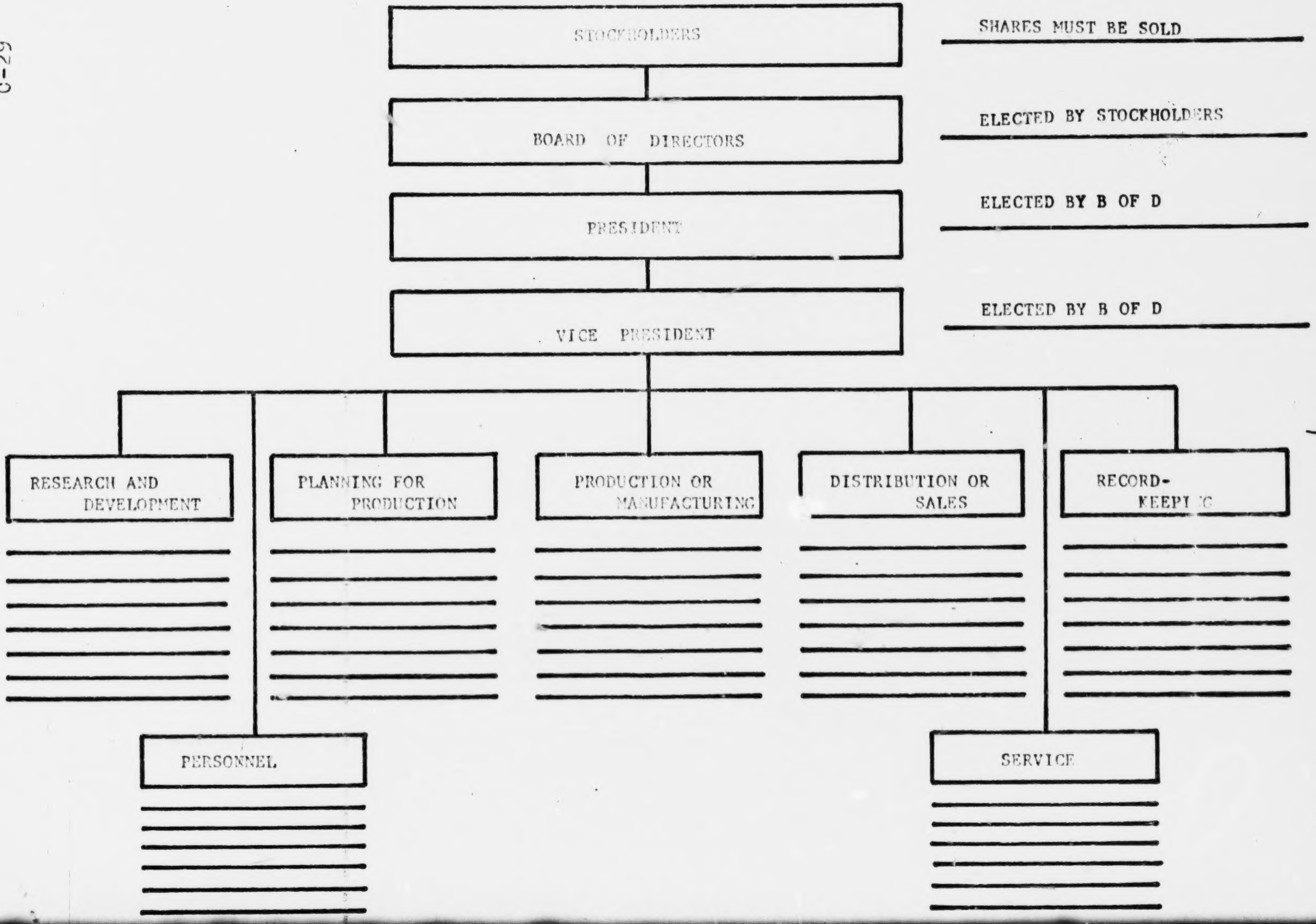

STOCKHOLDERS
SHARES MUST BE SOLD
BOARD OF DIRECTORS
ELECTED BY STOCKHOLDE
PRESIDENT
ELECTED BY B OF D
VICE PRESIDENT
ELECTED BY B OF D
CHIEF RESEARCHER
CHIEF ENGINEER
PRODUCTION MANAGER
SALES DIRECTOR
PERSONNEL DIRECTOR
SERVICE DIRECTOR

⑤

C-29

c-29

STUDENT CORPORATION


STOCKHOLDERS
SHARES MUST BE SOLD
BOARD OF DIRECTORS
ELECTED BY STOCKHOLDERS
PRESIDENT
ELECTED BY B OF D
VICE PRESIDENT
ELECTED BY B OF D
RESEARCH AND DEVELOPMENT
PLANNING FOR PRODUCTION
PRODUCTION OR MANUFACTURING
DISTRIBUTION OR SALES
RECORD-KEEPING
PERSONNEL
SERVICE

to make a final decision on the important division to be used in the personnel administration.

Post test

List what you would consider five major considerations in personnel administration:

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

HAND OUT SHEET

PERSONNEL ADMINISTRATIVE PROBLEMS

Recruiting, selection, and placement--These are the primary activities of the employment department, whose function is to fill employment requisitions submitted by foremen, department heads, and other line executives. Recruiting involves: 1) Determining the requirements or specifications for jobs through job description and analysis, 2) Gathering data about applicants, and 3) Comparing applicants with job data to determine who best fulfills the requirements.

Selection--This involves valid predictions from application blanks, trained interviewing, tests, skills and abilities, and other means of data collection and analysis.

Training--A major task is to develop the training skills of all those in the company. A training director usually finds it advantageous to run a number of programs continuously as an apprenticeship training program, a company technical training institute, or a rotational training program for engineers, or executive development seminars.

Promotions and Transfers--The personnel department becomes involved in promotions and transfers of employees for a number of reasons: 1) It is clearinghouse for labor requisitions for filling job vacancies, 2) It maintains a seniority list and is actively concerned with job assignments, and 3) The personnel department has the task of aiding in maintaining high morale and job satisfaction on the part of workers.

Wage Administration--This department has the responsibility of developing and maintaining wage-rate structures, conducts wage surveys, and participates in negotiating wage agreement and economic analysis.

Employee Services--Personnel provides such services as employee counseling, referral service, veteran's guidance and information, sponsorship of hobby groups, recreational activities, administration of health and insurance benefits, and employee suggestion systems.

TEACHER PACKAGE

ORGANIZATION AND MANAGEMENT

ORGANIZATION PROCESSES: COORDINATION

Objective:

Upon the completion of this lesson the student will be able to:

1. Define coordination
2. List at least three methods of achieving coordination.

Activity:

This class activity will demonstrate to the class the importance of coordinated activity in industry and how it might relate to the class activities.

Begin the lesson by defining the term coordination. This is the process whereby an executive develops an orderly pattern of group effort among his subordinates, and secures unity of action in the pursuit of common purposes.

How important is coordination:

Coordination is important as a first principle in organization. Its primary effect is found in the efficiency of business. It also has a significant effect on the development and retention of good personnel in business.

How do we achieve coordination:

Executives achieve coordinated efforts in their organizations through four main activities:

1. Clarifying authority and responsibility. There must be clear lines of authority and responsibility and minimum of overlapping authority. Where overlapp ing of authority does exist, coordination is required to minimize undesirable effects which might otherwise ensue.

2. Careful checking and observation. Checking and observing are control procedures. The executive takes systematic notice of actions by subordinates, looking particularly for actions that are out of harmony with one another.

3. Facilitating effective communication. Communication process as a tool is essential. There are two devices used, first is the use of committees, and the second is the use of group decision-making techniques.

4. Utilizing leadership skills. Motivating aspects of leadership are vital to coordinated effort. A leader can motivate individuals to a large extent to think in terms of company-wide, coordinated action.

Here is a list of criteria for successful coordination:

1. It is not forced by autocratic direction, but is fostered by leaders who understand the value of participation in management.

2. It is timely and extends in a balanced fashion to all parts of the organization, and operates horizontally as well as vertically.

It may be suggested that coordination must contain the following elements:

A. It must be a continuous process.
B. It must be direct between the persons immediately concerned.
C. It must start at the outset of the activity

The method of facilitating effective coordinating may be the result of:

a. Committees and coordination
b. Group decisions and coordination
c. Communication channels
d. Staff meetings

The student should remeber that coordination is that activity which is designed to establish unity of effort toward a common purpose. It is the blended, integrated, total performance that is of primary consideration. Therefore, through effective leadership, communication, group decision, and participative approaches to management, executives can achieve adequate coordination.

STUDENT ACTIVITY

Activity:

1. Students and teacher should discuss previous pages of this lesson.
2. Have students give examples of their experiences where coordinated effort has been the difference between success and failure.
3. Students may look back at previous pages of this lesson to channel their thinking.
4. Have students make suggestions on what they think would contribute to success in an organization from the standpoint of coordination.
5. The class will decide from the list of suggestions the ones they would like to use for the class enterprise.

POST TEST

A. Define coordination.

____

____

____

B. Briefly explain the importance of coordination.

____

____

____

C. Give suggested ways by which coordination may be achieved.

____

____

____

FOR THE TEACHER

ORGANIZATION AND MANAGEMENT

FACTORS AFFECTING INDUSTRY

Objective:

Using a list of suggested related topics about industry, the students will develop reports to broaden their understanding of industry.

Activity:

The teacher will make the following suggestions from which the students will select a topic for a report. The students will be free to add to this list.

A. Mass Production
B. Automation and Cybernetics
C. Labor-Management Relations
D. Finance
E. Industry-Government Relations
F. The Market Economy
G. Production Planning and Control
H. Marketing
I. Accounting

1. It is felt that through the medium of discussion the student will get an overall view of some of the special concepts of industry.
2. In making reports, students may use guest speakers, or movies.
3. Students may decide to select a chairman to coordinate dates and discussions.
4. Record the names of the volunteers, topic, and dates the discussion will take place.
5. In order to assist the student in preparation of his report, a resource list should be placed with the librarian.

Resource materials:

1. Goetz, B. E., Management Planning and Control.
2. Bryan, Leslie A., Traffic Management in Industry.
3. Landy, Thomas M., Production Planning and Control.
4. Carrol, Phil, How to Control Production Cost.
5. Halsey, George D., Industrial Relations Handbook.
6. Filipetti, George, Industrial Management in Transition.
7. Diebold, J., Automation: The Advent of the Automatic Factory.

ORGANIZATION AND MANAGEMENT

MASTER PLAN FOR THE DEVELOPMENT OF PERSONNEL ACTIVITIES

OBJECTIVE:

Upon the completion of this lesson the student will be able to:

1. Name at least five parts of a master plan
2. Design a plan for their company using this master plan as a guide.

ACTIVITY:

One recommendation which is repeatedly made by many personnel executives emphasizes the advantage that lies in formulating a written plan outlining the proposed activities of a newly organized personnel department. Therefore in preparation for the class to design its plan, a basic guide is provided for study. The class will be concerned with the following:

1. Designing a master plan which will meet the needs of their company.
2. Students should refer back to package NO. C-8 to establish a framework for their thinking.
3. After carefully reading page two of this lesson, members of the class will make recommendations for use in their company.
4. The class will select a committee to write up these recommendations.
5. One week later this committee will report and present completed master plan to the class.

POST TEST:

1. Name any five parts of the master plan.

   1.____________ 2.__________ 3.____________ 4.____________
   5.____________

2. Take any one of these five parts you have listed and show how it is important to organization.

HANDOUT SHEET NO. C-15

GUIDE FOR MASTER PLAN DEVELOPMENT

1. Selective Employment:

   A. Better organization of existing sources of supply of applicants, development of new sources which heretofore have not been utilized, to include the placement services of high schools, trade schools, colleges, and public and private agencies dealing with special groups

   B. Design of a standard personnel requisition blank for use by operating departments in requesting personnel; the form will contain necessary details on the job to be filled and type of worker needed, and will be used in conjuction with the job specifications to be developed.

   C. Design of a uniform application blank to record such items as education, past experience, etc.

   D. Introduction of a testing program to supplement the interview.

   E. Physical examination appropriate to the job will precede employment.

11. PLACEMENT:

   A. Assignment of employees to jobs for which they appear best qualified on the basis of the selection techniques.

   B. Uniform procedures for introducing new employees to the company.

111. TRAINING AND EDUCATION:

   A. Pre-job training in cooperation with local public vocational training organizations

   B. Effective in-service training of new employees.

   C. Development of programs for training of understudies, junior executives, subforemen, etc.

   D. Organization of the supervisory training program to be started during second year.

IV. JOB ANALYSIS AND JOB EVALUATION:

A. Analysis of each managerial, production, and clerical job to determine the nature of the work; the qualifications necessary; the nature and amount of training required, and the amount of supervision necessary.

V. WAGES AND INCENTIVES:

A. Formulation of wage scales in each job classification, with periodic review as a basis for recommendations to management.

B. Provision for stability of employment, insofar as possible, through careful scheduling of operations and financial planning.

VI. HEALTH AND SAFETY:

A. Provision of more adequate first-aid facilities.

B. Education of employees in safety and health to be a continuous function.

VII. SECURITY PLANS:

A. Extension of group life insurance coverage.

B. Hospitalization plan.

C. Sickness, disability, and accident insurance.

VIII. RESEARCH PROJECTS: (At least one formal research project to be carried on each year)

A. Evaluation and improvement of employment methods.

B. Study of labor turnover.

C. Investigation of employee rating plans to determine adaptability to our needs.

D. Evaluation of employment tests on basis of subsequent service record of tested personnel.

IX. INDUSTRIAL COMMUNITY RELATIONS:

A. Government agencies

B. Citizens' organizations.

C. Newspapers.

D. Influential individuals.

FOR THE STUDENT

ORGANIZATION AND MANAGEMENT

DESIGNING A JOB DESCRIPTION SURVEY

Objective:

You will design a job survey questionnaire by writing a list of questions which will provide:

1. A written account of the work included in the job.
2. The job's relationship to other jobs.
3. A listing of the assigned tasks for this position.
4. Duties and responsibilities of the employees.
5. Work operations to be performed.

Activity:

1. Select a committee to design the job survey questionnaire.
2. Read the information on Page 2 as an aid in gathering information.
3. Write a list of questions that will provide the necessary information.
4. Each committee member should now design a sample job survey form.
5. Select the best form, or redesign samples into final copy.
6. Using the survey form, have each department of the company complete the forms.
7. Evaluate the survey forms.
8. See sample form on Page 3 of this lesson.

THE JOB SURVEY

Job descriptions are important because they help tell the employees what is expected of them, and what their responsibilities and authorities are. Personnel performs a worthwhile service to manufacturing by developing job descriptions.

Job descriptions provide a foundation from which to compare jobs inside the company with others outside it in order to take full advantage of industry, community, intercompany, interdivision, and other compensation surveys. They are necessary in a management development program because they permit more accurate analysis of the requirements for satisfactorily filling jobs.

Descriptions are an aid in recruiting, hiring, and placement, since they form the basis for written specifications listing the requirements for satisfactorily matching the person with the job.

In organizational planning, descriptions are used to analyze and improve the organization structure. They indicate whether all corporate responsibilities are fully covered and show when reallocation of assignments would lead to better balance within the company.

GUIDE FOR EVALUATION OF A JOB SURVEY FORM

1. Has the form included the following?:
    - a. name of the job
    - b. skill needed for job
    - c. responsibilities
    - d. sex
    - e. experience required
    - f. educational requirement
2. Are the questions easy to understand?
3. Will the answer to questions aid management in decisions?
4. Will the form be easy to use by the surveyor?

JOB DESCRIPTION SURVEY
(sample)

Department____________________ Standard Code______________

Subdivision___________________ Standard Title_____________

Branch of Plant_______________ Plant Title________________

Date__________________________ Plant Code_________________

Summary of duties:

Detailed statement of work performed:

Source of supervision:

Tools and equipment:

Materials:

Responsibility:

Qualifications required:

1. Special knowledge
2. Previous experience
3. Physical

Working conditions:

1. Surroundings
2. Hazards

Relation to other jobs:

1. Promotion from
2. Promotion to

Job Analyst___________________________

Approved by __________________________ Date ____________________

TEACHER PACKAGE

No. C-16

ORGANIZATION AND MANAGEMENT

POLICY FORMULATION FOR A COMPANY

Objective:

Given the definition, and the objectives or purposes of policy, the student will write at least one policy statement for a company.

Activity:

One of the major tasks of management in any business is the formulation of policy.

1. A policy is a statement of a course of action which serves to guide all elements of the company to a common objective. It expresses the attitude of top management toward a particular situation, either within or outside of the company. It defines the company's philosophy in particular areas or activities. Thus, we find that companies have personnel policies, credit policies, price policies, etc., each describing some specific aspect of the attitude of management. Some typical examples are:

    A. We always promote the senior man.
    B. We do not extend credit beyond ninety days to any customer.
    C. We maintain sufficient raw materials for one week of production.
    D. Our workers work overtime only at their own request.

   Policies tell how to handle conditions that may arise in the future. For example, there may be a policy that public statement will be made only by the president and selected officers. This advises all concerned that any questions raised by the press must be referred to these individuals.

   Suggestions, recommendations, or requests for expressions of policy will come from the operating or staff executives, or may originate at the board of directors level.

2. Discuss the objectives of policy statements listed below:

   A. To communicate executive decisions to other individuals who are responsible for carrying out the various operations of the company.

   B. To delegate authority to the decentralized units of the company for taking action under certain prescribed circumstances.

   C. To eliminate the necessity of operating executives. referring every problem to top management for decision.

   D. To coordinate the company's efforts in attaining the overall objectives.

When policy has become a record, known to both the worker and customer, the results are beneficial for the firm and its customers. Again, a clear policy assures uniform behavior in repeated situations, and this is highly desirable whether the company is dealing with its workers or its customers. Finally, clear policies relieve management of the need for making the same decision over and over again. A good policy ought to be followed consistently, for uniform actions tend to create good will among all parties concerned. Further, policies should not be made unless there is a real need for guidelines in a particular area of activity.

FOR THE STUDENT

No. C-16

When completed, submit to the teacher for evaluation

3. Post-test:

A. Define policy

____

____

____

B. State the purpose of policy

____

____

____

C. Given one example of policy statement

____

____

____

FOR THE STUDENT

No. C-17

ORGANIZATION AND MANAGEMENT

SELECTING AN EDUCATIONAL DIRECTOR

Objective:

Given a sheet containing information about the responsibilities of the educational director, and a selection procedure, you will select one student to function as educational director for your corporation.

Activity :

Answer the following questions: (Refer back to package C-8)

1. What is the job of an educational director?

____

2. List the main responsibilities of the educational director.

____

____

3. Carefully read page two of this lesson.
4. Select one student as your educational director. Selection procedure may follow steps 5, 6, 7, 8, 9, and 10 of package No. F-1.

DUTIES OF EDUCATIONAL DIRECTOR

No. C-17

1. Plans and supervises a program to increase the interest and competence of all employees through specialized training.

2. Develops and maintains a program designed to orient new employees.

3. Prepares and distributes training literature.

4. Cooperates with outside agencies in educational projects.

Directing training programs is a vital part of industry. A substantial portion of the work force will have to be retrained during the next decade to fill the new positions that will be created by automation and increased mechanization. The skills of millions of employees will have to be upgraded to qualify them to undertake the more complicated assignments, especially in maintenance, that automation will create, and millions of unskilled or semiskilled workers will have to be trained so that they can shift to new jobs when their old ones have been rendered obsolete.

Training and Education: (should be responsible for)

A. Pre-job training in cooperation with local public vocational training organizations.

B. Develop more effective in-service training of new employees.

C. Development of program for training of understudies, junior executives, subforemen, etc.

D. Development of a company library to include books, pamphlets, magazines, etc., of interest to all classes of personnel.

TEACHER PACKAGE

ORGANIZATION AND MANAGEMENT

DUTIES OF THE SAFETY DIRECTOR

Objective:

After studying this lesson, the student will be able to name at least four responsibilities of the safety director.

Activity:

Have students refer back to package C 8, which represents the total graphical view of administration. This package (C-18) will examine and describe the duties of one member of the Board of Personnel Directors.

1. The duties of the safety director are:
    - A. Directs the development and administration of safety devices and safety procedures.
    - B. Conducts periodic inspection of equipment and materials in order to decrease frequency and severity of accidents.
    - C. Conducts safety campaigns and contests.
    - D. Maintains accident records.
2. Using the listed duties of the safety director as a guide the students will describe what their safety program will include for their company.
3. Package No. F 3 will act as an aid in developing the details of this program.
4. The hand-out sheet for this lesson will give more information on the safety directorship and the vital importance of such a program.

Post test:

Name four duties of the safety director:

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

A consistently good safety record doesn't come about through chance alone. Companies that enjoy good safety records have had to spend much time and effort working toward that goal. This time and effort is coordinated by the safety director. Sometimes the coordinated effort is called a safety program. Analysis of most successful safety programs will disclose that they contain the four "E's" - Engineering, Education, Enlistment, and Enforcement.

Cost of Accidents - There are definite costs associated with accidents. Some are direct and measurable; others are indirect and somewhat intangible, but nevertheless real. Companies pay for the cost of accidents in three ways: 1) Medical and hospital care that may be required by the injured employee. 2) Weekly payments to the injured employee computed as a percentage of his regular weekly wages continuing for as long as the employee is unable to work. 3) Increased rates of compensation insurance.

Evaluation of the Safety Program: The safety director has the responsibility for evaluating his program. The first problem in evaluation is the definition of an "accident." In general an accident is any unforeseen event that causes personal injury or property damage. A common way to categorize accidents is as follows:

A. Minor Injuries - All injuries that can be adequately treated in the company hospital or dispensary.

B. Compensable Injuries - These are injuries that require treatment beyond routine first aid but that do not result in the employee's losing time from his job.

C. Lost-time accident - This kind of accident causes the employee to lose time from his job either immediately or sometime later. The accident becomes lost time if the worker fails to return the next day or some subsequent day.

FOR THE STUDENT

NO. C-19

ORGANIZATION AND MANAGEMENT

PREPARING APPLICATION BLANKS

Objective:

Given a sheet of paper (8 1/2 X 11) and examples of application forms, you will make up your own application forms.

Activity:

1. Examine the application forms given to you on page two of this lesson. Then determine the information and data you would like to include in your form to make it complete. You may also wish to review package F-5.

2. To design your application from you must have the following materials:

   a. Paper-unlined

   b. Scissors

   c. Ruler

   d. T-square (if possible)

   e. Pencil

3. Using the application forms given as a guide, proceed to design your application blank.

4. If you are not pleased with the appearance and content of your form, try again on another sheet of paper.

5. Show the completed form to your teacher.

THE APPLICATION FORM

NO. C-19

The selection procedure in getting potential employees is the use of the application blank. This form supplies detailed information about the applicant. The application blank should call for information that has bearing on the fitness of the applicant for the job. The form should be as simple as possible.

Sample forms

APPLICATION FOR EMPLOYMENT

Print your full name
first middle last

Street Address Nearest Tel.

City State Social Security No.

How long at this address

Age Date of Birth
(Mo.) (Day) (Year)

Height Weight

Married?
Single?
Widowed?
Divorced? __________ Sex ______ Sports Hobbies __________

Number of Children __________ List other Dependents ________ Have you any physical defects ___

How many days have lost by illness in past 2 years __________

Were you ever employed by this company __________ Name of relatives or friends working here

Education ________ Name of school ______________ Location

NO. C -19

Education continued: (Student may wish to include this information)

Education	Name of school	Location	Years Attended	Years Completed	Graduated?
Grammar school			19___ to ___		
High school			19___ to ___		
Other education or training			19___ to ___		

I declare and warrant that the answers made herein are correct and true and that I am willing to undergo a physical examination and be fingerprinted.

Name of company may appear here. Signed ________________ Date ________

This information may appear on the opposite side of form

Record of Employment: Are you now employed ______ If not, how long have you been uneployed? ____________________. Trade or occupation ______ Other work _______

Beginning with your present or last position, record below complete details of your exreience.

From	To	Employer	Address	Wage	Duties	Reason for leaving

What is the best job you have ever had? Employer ____________ Address __________ Occupation ____________

Service in U.S. Armed Forces? Branch of Service ________ Rate or Rank __________ Date From __________________

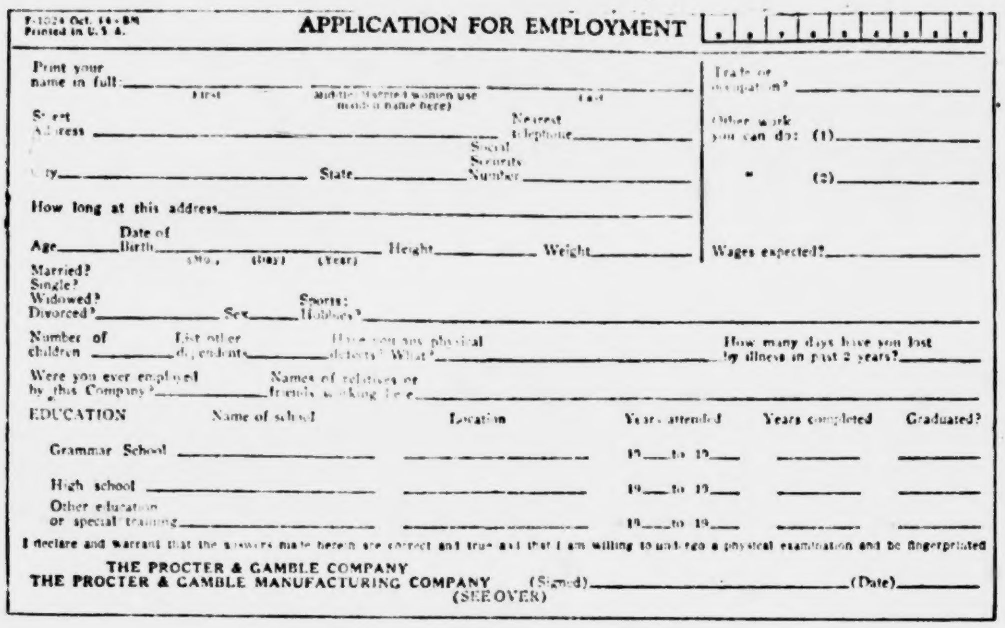
Type of Discharge ______________________

APPLICANT WILL NOT USE THIS SPACE

Remarks: ____

Date ____________ Signed ________________________________

SAMPLE FORMS



F-1024 Oct. 14-BN
Printed in U.S.A.

APPLICATION FOR EMPLOYMENT

Print your name in full: ____ First ____ Middle (Married women use maiden name here) ____ Last

Street Address ____ Nearest telephone ____

City ____ State ____ Social Security Number ____

How long at this address ____

Age ____ Date of Birth ____ (Mo.) (Day) (Year) Height ____ Weight ____

Trade or occupation? ____

Other work you can do: (1) ____

(2) ____

Wages expected? ____

Married? Single? Widowed? Divorced? ____ Sex ____ Sports: Hobbies? ____

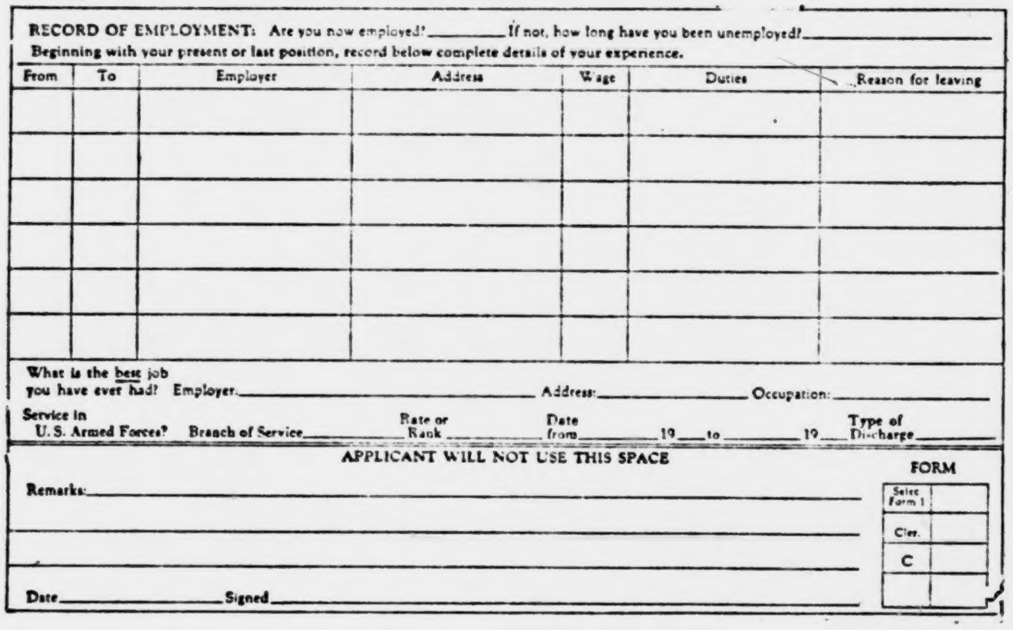
Number of children ____ List other dependents ____ Have you any physical defects? What? ____ How many days have you lost by illness in past 2 years? ____

Were you ever employed by this Company? ____ Names of relatives or friends working here ____

EDUCATION	Name of school	Location	Years attended	Years completed	Graduated?
Grammar School			19__ to 19__		
High school			19__ to 19__		
Other education or special training			19__ to 19__		

I declare and warrant that the answers made herein are correct and true and that I am willing to undergo a physical examination and be fingerprinted

THE PROCTER & GAMBLE COMPANY
THE PROCTER & GAMBLE MANUFACTURING COMPANY (Signed) ____ (Date) ____
(SEE OVER)



RECORD OF EMPLOYMENT: Are you now employed? ____ If not, how long have you been unemployed? ____

Beginning with your present or last position, record below complete details of your experience.

From	To	Employer	Address	Wage	Duties	Reason for leaving

What is the best job you have ever had? Employer ____ Address: ____ Occupation: ____

Service in U.S. Armed Forces? Branch of Service ____ Rate or Rank ____ Date from ____ 19__ to ____ 19__ Type of Discharge ____

APPLICANT WILL NOT USE THIS SPACE

Remarks: ____

Date ____ Signed ____

FORM

Selec Form 1	
Cler.	
C	

TEACHER PACKAGE

ORGANIZATION AND MANAGEMENT

ORGANIZATION DESIGN FOR A STUDENT CORPORATION SHOWING IT'S MAJOR SUBDIVISIONS AND FUNCTIONS OF EACH

OBJECTIVES:

As result of the following lessons beginning with C-20 thru C-28, the students will:

1) Select one subdivision in which they will work.
2) Write the functions of the selected subdivision.

ACTIVITIES:

1) Issue hand sheets.

2) Using the information on the handout sheets, (pages 2 and 3), discuss with the class the functions of each division of a corporation.

3) Complete package C-21.

4) After completing package C-21, the students should be divided into seven groups.

5) Within each group, the students will elect a leader.

6) Issue one of the packages (C-22 to C-28) to each group.

7) Have each group discuss it's subdivision and make an oral report of their findings to the class.

8) Below the organizational chart, on page 3 of this package, have the student write or list the subdivision that he is most interested in and give the functions of that subdivision.

9) In a number of the packages, I have referred to other packages for additional help. Please make these packages available for the students.

SUBDIVISIONS:

Management is the assumption of the responsibility for leadership of a group toward the achievement of it's objectives. To accomplish these objectives, there must be planning, organizing, directing, and controlling.

Research and Development's aim is to improve it's product and to find means and ways of manufacturing the product at the lowest cost.

Planning for Production and Manufacturing Operations- To determine, design, and develop effective uses of the plant's research in producing the best product utilizing it's basic facilities.

Production or Manufacturing - Production is the output of the productive forces in manufacturing products.

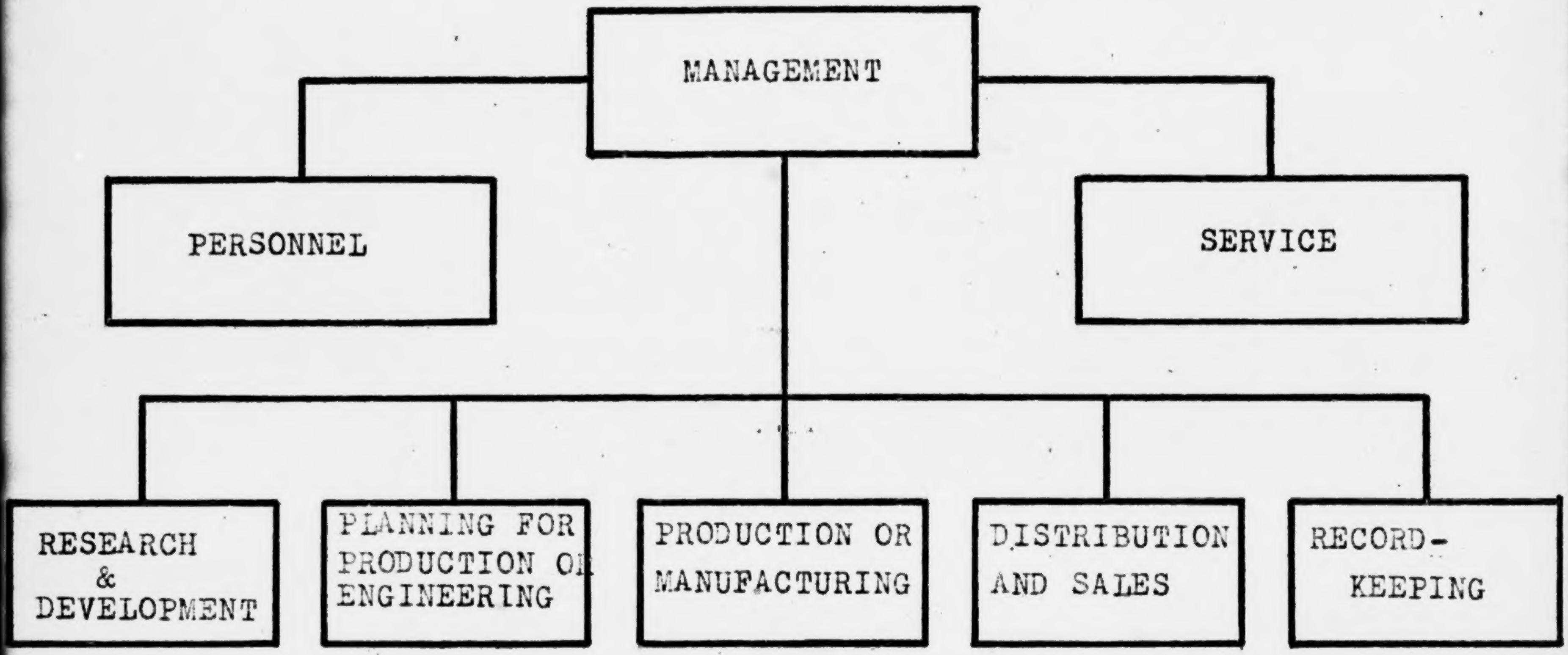
Distribution or Sales - To plan how to distribute the product. (Making the product available to the customer).

Service - To service the equipment, facilities, and the product.

Personnel - To provide good working conditions, labor relations, and insure or guarantee uninterrupted production.

Record Keeping - To keep records of profits and losses.

HANDOUT SHEET


MANAGEMENT
PERSONNEL
SERVICE
RESEARCH & DEVELOPMENT
PLANNING FOR PRODUCTION OR ENGINEERING
PRODUCTION OR MANUFACTURING
DISTRIBUTION AND SALES
RECORD-KEEPING

AN ORGANIZATIONAL CHART OF A TYPICAL STUDENT CORPORATION

Tear Off - - - - - - - - - - - - - - - - - -

COMPLETE THIS HALF OF THE SHEET.

1) Department selected

____

2) State the purpose of the department.

____

____

____

____

3) Submit to the teacher for evaluation.

STUDENT PACKAGE

C-21

ORGANIZATION AND MANAGEMENT

STRUCTURAL RELATIONSHIP OF THE ORGANIZATIONAL DEPARTMENTS

OBJECTIVE:

Given the functions, departmental names, and titles of each chairman within a department, the student will write the names of each department chairman or head.

PREREQUISITE:

Each participant must have completed lesson C-20 before starting this one.

ACTIVITIES:

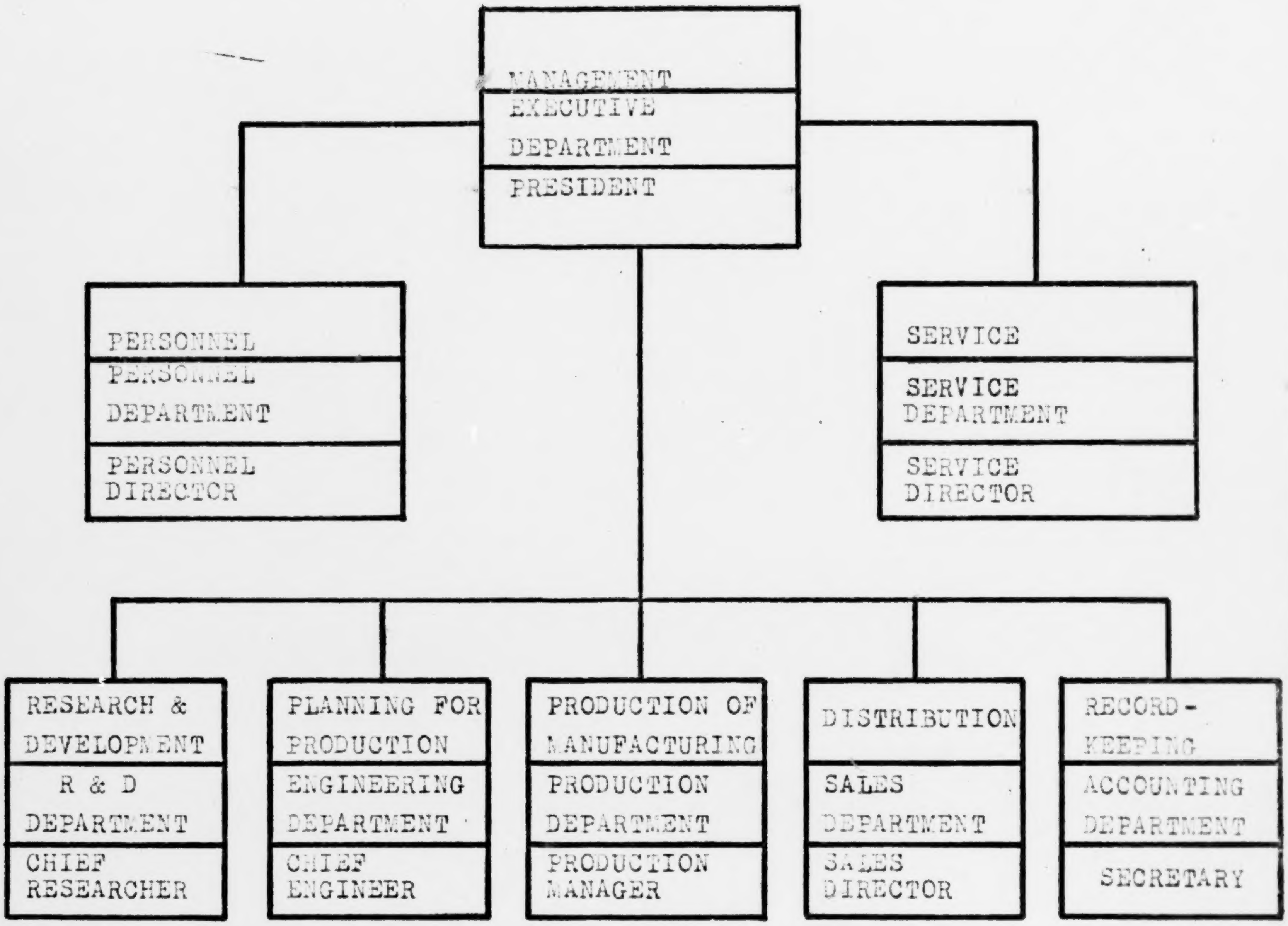
1) Study the handout sheet which shows a typical student corporation structure of the functions, department names, and the title of chairmen or heads.

2) Noted, the chart has been arranged as to:

Functions
Department Names
Head of Department

POST-TEST:

With the aid of the handout sheet, write or list the names of the chairmen or heads of the departments.


MANAGEMENT
EXECUTIVE DEPARTMENT
PRESIDENT
PERSONNEL
PERSONNEL DEPARTMENT
PERSONNEL DIRECTOR
SERVICE
SERVICE DEPARTMENT
SERVICE DIRECTOR
RESEARCH & DEVELOPMENT
R & D DEPARTMENT
CHIEF RESEARCHER
PLANNING FOR PRODUCTION
ENGINEERING DEPARTMENT
CHIEF ENGINEER
PRODUCTION OF MANUFACTURING
PRODUCTION DEPARTMENT
PRODUCTION MANAGER
DISTRIBUTION
SALES DEPARTMENT
SALES DIRECTOR
RECORD-KEEPING
ACCOUNTING DEPARTMENT
SECRETARY

AN ORGANIZATIONAL CHART SHOWING

THE STRUCTURAL RELATIONSHIP OF THE ORGANIZATIONAL DEPARTMENTS

HANDOUT SHEET

LIST THE HEADS OF EACH DEPARTMENT

1) Executive Department

____

2) Research and Development Department

____

3) Engineering Department

____

4) Production Department

____

5) Sales Department

____

6) Accounting Department

____

7) Personnel Department

____

8) Service Department

____

STUDENT PACKAGE C-22

ORGANIZATION AND MANAGEMENT

A TYPICAL RESEARCH AND DEVELOPMENT DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.

2) Read the functions very carefully.

3) To reach the objective of this package, the entire group must participate.

4) The group leader will conduct a discussion of the subdivision you have in your hands.

5) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about).

FUNCTIONS:

Original Concept - Deals with original ideas that can be developed into commercially profitable products. This involves the areas of fundamental and applied research where these ideas can be fully researched, developed and improved to the point where products can be competively produced and sold for a profit.

Market Evaluation - Deals with determining the best possible sales potential of a product.

Product Research - Consists of creating new products and improving the existing products.

Process Research - To be found on Page 2.

Material Research - To improve the existing materials and develop new ones. Primarily, it is designed to make the best use of the materials available.

FUNCTIONS: (Cont'd)

Market Research - Consists of a continuing search for new uses for existing products. It also includes product analysis, market analysis, and channel analysis. (A complete analysis of the marketing of products or service is essential to determine it's feasibility.)

a) Product analysis consists of an analysis of the product and it's characteristics.

b) Market analysis refers to an analysis of the people who buy the product.

c) Channel analysis refers to the method by which the product is distributed from the producer to the customer.

Process Research - Deals with improving the existing processes, and developing new processes for new and old materials to meet the changing demands of industry.

NOTE: Consult your teacher for the list of packages below if you need additional help in Research and Development.

Original Concepts: D-1, D-3, D-4, D-6

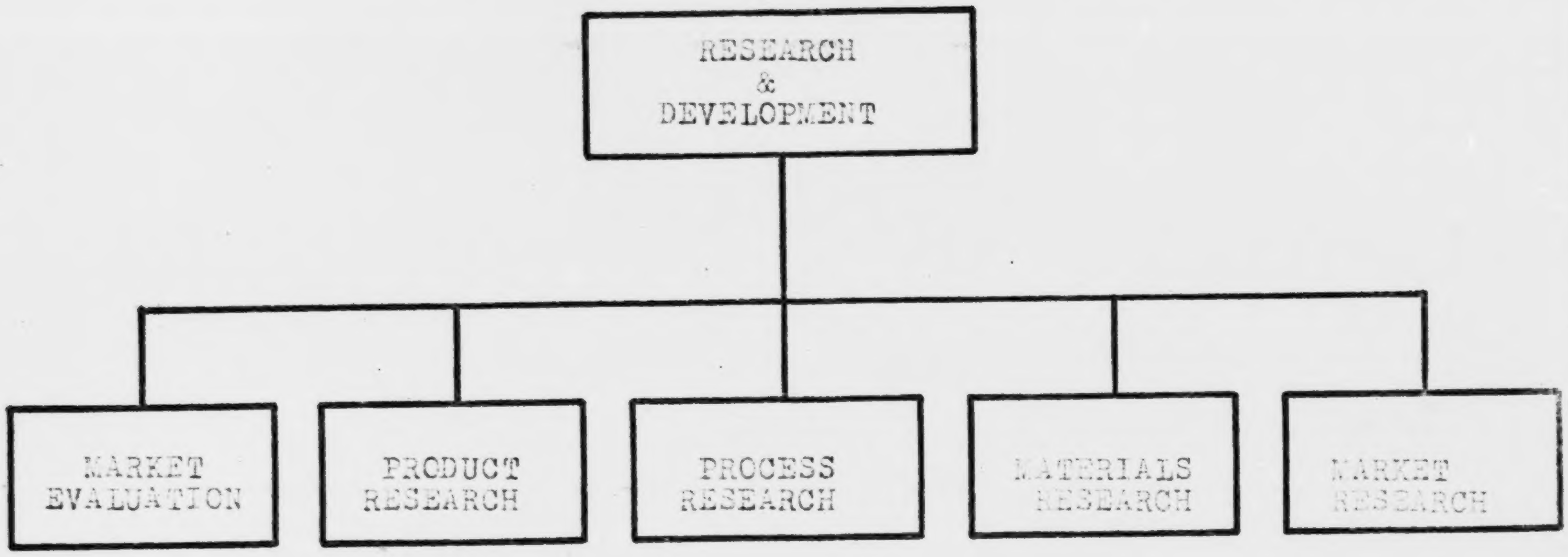
Market Evaluation: D-7

Product Research: D-11 thru D-16

Process Research: D-17 thru D-21

Material Research: D-32, D-33

Market Research: D-34, D-35, D-36, D-37, D-38, D-39, D-40, D-41


RESEARCH
&
DEVELOPMENT
MARKET EVALUATION
PRODUCT RESEARCH
PROCESS RESEARCH
MATERIALS RESEARCH
MARKET RESEARCH

ORGANIZATION AND MANAGEMENT

A TYPICAL ENGINEERING DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.

2) Read the functions very carefully.

3) To reach the objective of this package, the entire group must participate.

5) The group leader will conduct a discussion of the subdivision you have in your hands.

4) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about).

FUNCTIONS:

Material Specifications - An accurate statement of the technical requirements that determine the description of the material.

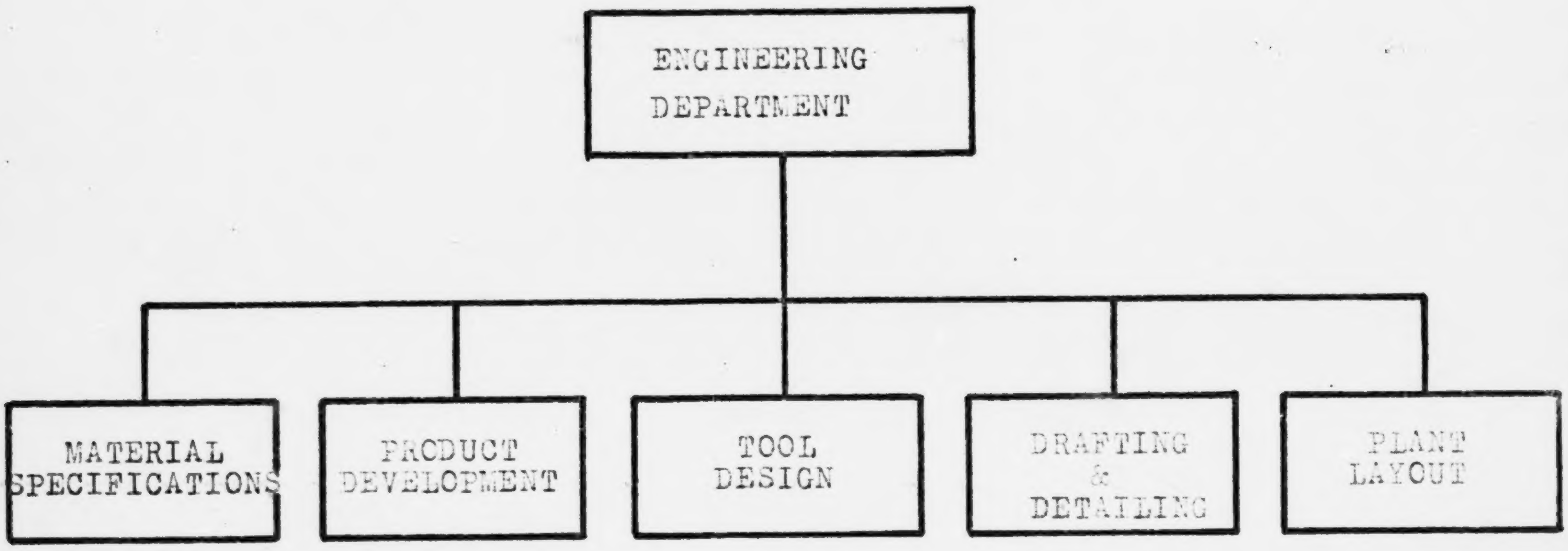
Product Development - Is a bridge between research work and engineering work. The work of product development consists of making several product designs and then testing and evaluating these designs. (See Package E-2, E-5&6, and E-7)

Tool Design - Refers to the designing of tools, jigs, and fixtures to manufacture a new product. This work is done by industrial engineers. (See Package E-1)

FUNCTIONS: (Cont'd)

Drafting and Detailing - The functions of the draftsman and detailers are to convert the engineering sketches and layouts into workable drawings. These drawings must contain enough detail information for the manufacturing of the parts of the product.

Plant Layout - Consists of the location of the physical buildings as well as the tools, machinery, and other facilities in the building to make the product.


ENGINEERING DEPARTMENT
MATERIAL SPECIFICATIONS
PRODUCT DEVELOPMENT
TOOL DESIGN
DRAFTING & DETAILING
PLANT LAYOUT

ORGANIZATION AND MANAGEMENT

A TYPICAL PRODUCTION DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.

2) Read the functions very carefully.

3) To reach the objective of this package, the entire group must participate.

4) The group leader will conduct a discussion of the subdivision you have in your hands.

5) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about).

FUNCTIONS:

Operating - Consists of organizing the shops according to the manufacturing work demands. Thus, there may be a forge shop, a machine shop, a paint shop, an assembly room, and a cutting department to name a few.

Processes - The procedures of attaching or joining of materials, finishing, forming and binding.

Maintenance - Is concerned with the day-to-day problem of keeping the physical plant in good operating condition.

FUNCTIONS: (Cont'd)

Inspection - Is the component of the quality control program that is concerned with checking on the conformance of the item to the specifications set for it.

Quality Control - Refers to all of those functions or activities that must be performed to fulfill the company's quality objectives.

Materials - The substances requiring decisions based upon their intended usage, their behavior in service, and their behavior while being processed.

Inventory of Production Materials - The primary function is to control the material in manufacturing. The major concern is the "flow" of material from a "raw" state to a finish product.

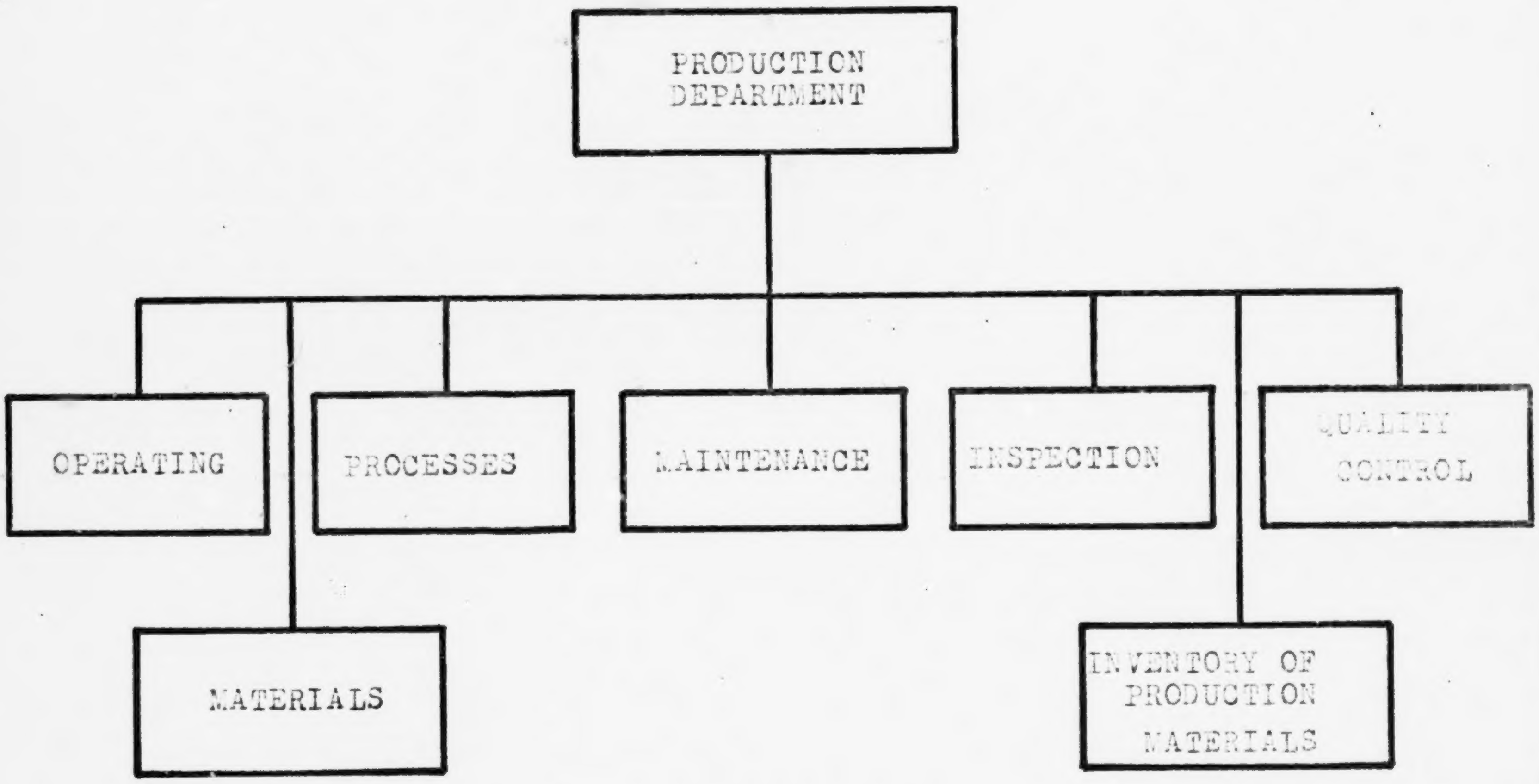
NOTE: Consult your teacher for the list of packages below if you need additional help in Research and Development.

Operating: F-1 thru F-9, F-11 thru F-13

Maintenance: F-30

Inspection: F-10, F-24, F-34

Quality Control: F-22


PRODUCTION DEPARTMENT
OPERATING
PROCESSES
MAINTENANCE
INSPECTION
QUALITY CONTROL
MATERIALS
INVENTORY OF PRODUCTION MATERIALS

STUDENT PACKAGE

ORGANIZATION AND MANAGEMENT

A TYPICAL DISTRIBUTION OR SALES DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.
2) Read the functions very carefully.
3) To reach the objective of this package, the entire group must participate.
4) The group leader will conduct a discussion of the subdivision you have in your hands.
5) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about.)

FUNCTIONS:

Advertising and Sales Promotion

a. Advertising's primary function is to inform the public of the availability of the product, and to convince the public that a particular product is better or superior to it's competitors.

b. Sales Promotion slightly differs from advertising, it is more involved in the kind of activities which have the purpose of making other sale efforts, such as making advertising more effective. Through sales promotion, many creative ideas are used to put on special display, offering premiums, running contests, and distributing free samples, and demonstrating products and their uses.

FUNCTIONS: (Cont'd)

NOTE: For additional information, see packages G-2 and G-3.

Marketing - Simply involves moving the finished products from the producer to the consumer as effectively as possible.

Packaging and Transportation

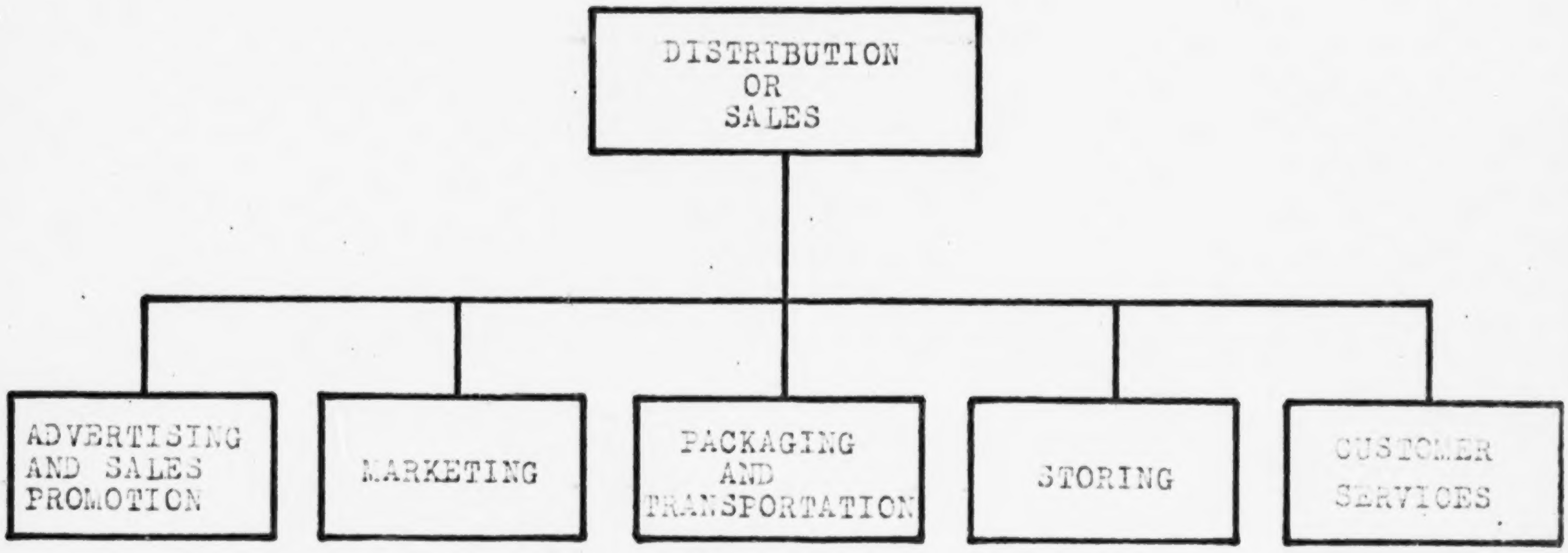
a. Packaging deals with designing containers to make the product more marketable to increase the customer's appeal.

b. Transportation deals with shipping or delivering the goods to the customers whether it be by railroad, water, air or truck transportation.

NOTE: See package G-20 for more information.

Storing - Is the actual storage of goods. Package G-23 gives the need for storing.

Customer Services - Is responsible for making adjustments, handle complaints, and most of all assuring the consumer a good product.


DISTRIBUTION OR SALES
ADVERTISING AND SALES PROMOTION
MARKETING
PACKAGING AND TRANSPORTATION
STORING
CUSTOMER SERVICES

ORGANIZATION AND MANAGEMENT

A TYPICAL RECORD-KEEPING DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.

2) Read the functions very carefully.

3) To reach the objective of this package, the entire group must participate.

4) The group leader will conduct a discussion of the subdivision you have in your hands.

5) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about).

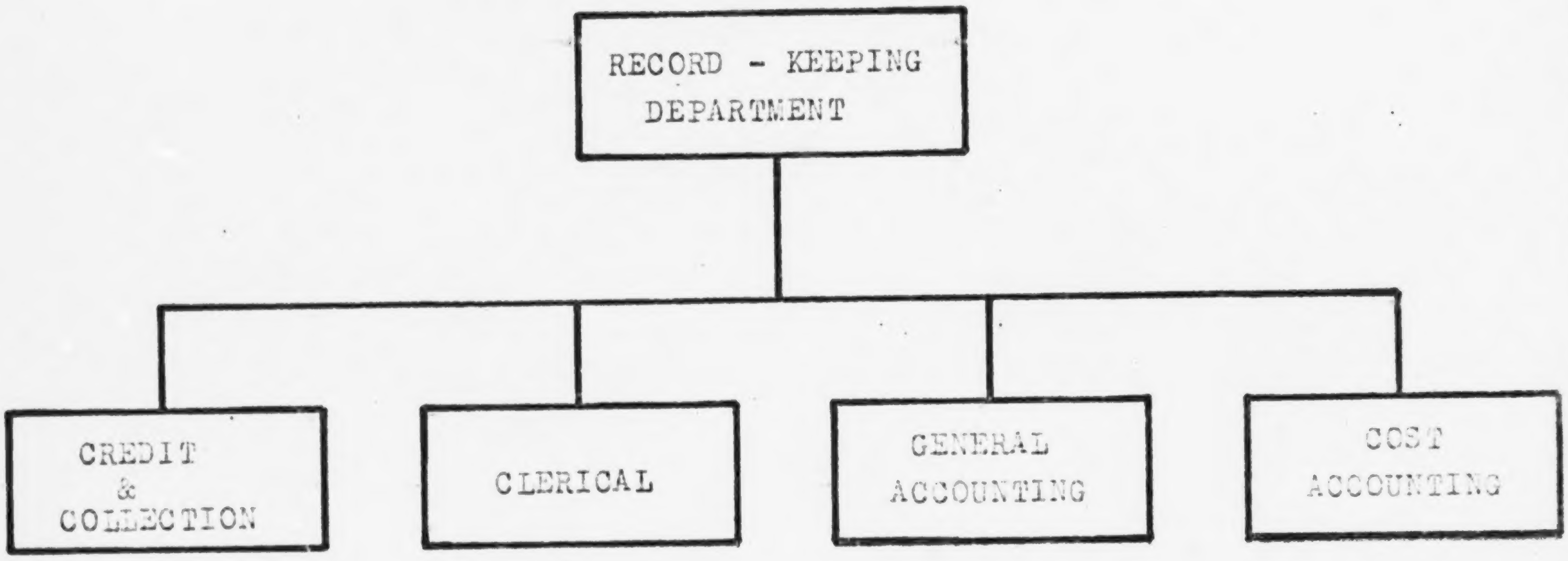
FUNCTIONS:

Credit and Collection - Credit deals with the policies of determining the ways of governing the granting of credit. Collection is the principle way of collecting the company's money but keeping the customers happy or pleased.

Clerical - Consists of filing, any office corresponding typing, and distribution of incoming mail.

General Accounting - Is the basic accounting function which reports periodically - either monthly or at least once a year - the profit and loss statement and the balance sheet.

Cost Accounting - Records of the actual costs of producing different products or a product.


RECORD - KEEPING DEPARTMENT
CREDIT & COLLECTION
CLERICAL
GENERAL ACCOUNTING
COST ACCOUNTING

ORGANIZATION AND MANAGEMENT

A TYPICAL SERVICE DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.

2) Read the functions very carefully.

3) To reach the objective of this package, the entire group must participate.

4) The group leader will conduct a discussion of the subdivision you have in your hands.

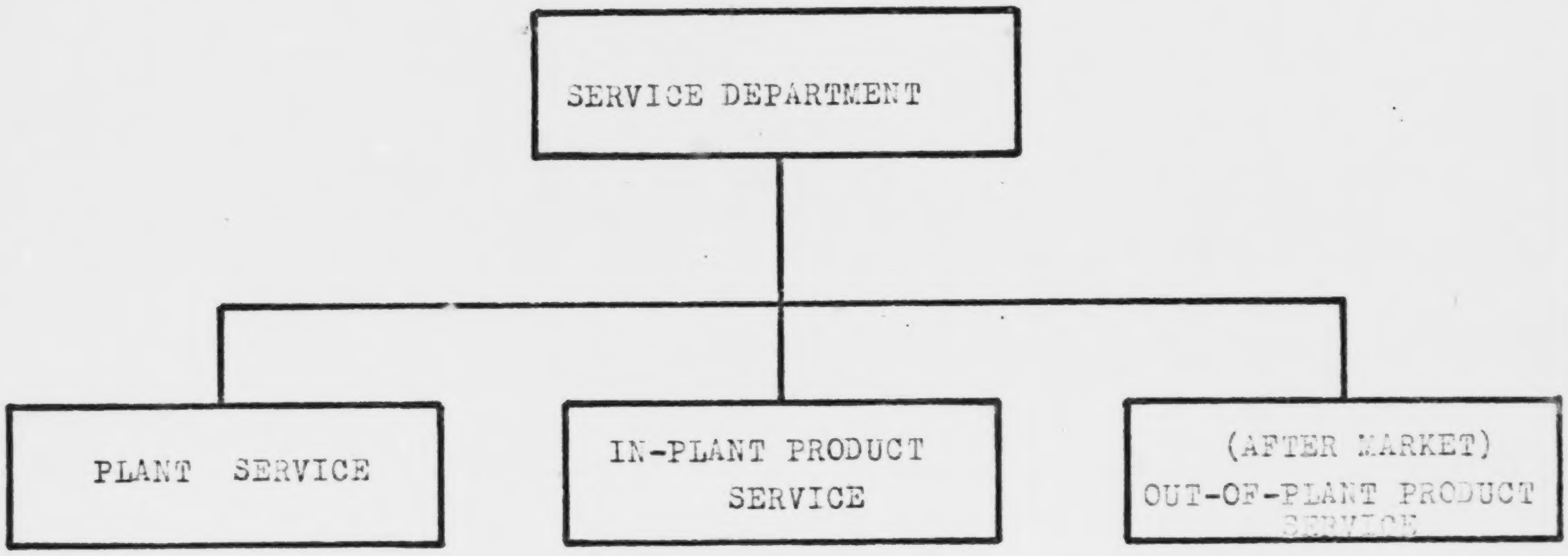
5) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about.)

FUNCTIONS:

Plant Service - Keeps up and takes care of the physical plant or property which includes all machinery, equipment, and the physical buildings themselves.

In-Plant Product Service - Takes care of the product - repair, correct, and sometimes alter the products being built in the factory complex itself.

Out-of-Plant Product Service - (After market) - Usually does not physically repair products themselves, but leaves it to other organizations such as: dealer service, garages, repair outlets, etc. Their connection is training service personnel in repair and up-keep of their product through servicement, teach-ins, clinics, etc., to keep repair or service people updated on the latest developments. This is usually done by having them come for a period of time to other main plants or service organizations of the parent company located in central locations throughout the country.


SERVICE DEPARTMENT
PLANT SERVICE
IN-PLANT PRODUCT SERVICE
(AFTER MARKET) OUT-OF-PLANT PRODUCT SERVICE

STUDENT PACKAGE C-28

ORGANIZATION AND MANAGEMENT

A TYPICAL PERSONNEL DEPARTMENT SHOWING IT'S SUBDIVISIONS AND FUNCTIONS.

OBJECTIVE:

Given the subdivisions and functions, the students of this group will give an oral report to the class.

ACTIVITIES:

1) If you encounter any problems, please ask for help from your teacher.

2) Read the functions very carefully.

3) To reach the objective of this package, the entire group must participate.

4) The group leader will conduct a discussion of the subdivision you have in your hands.

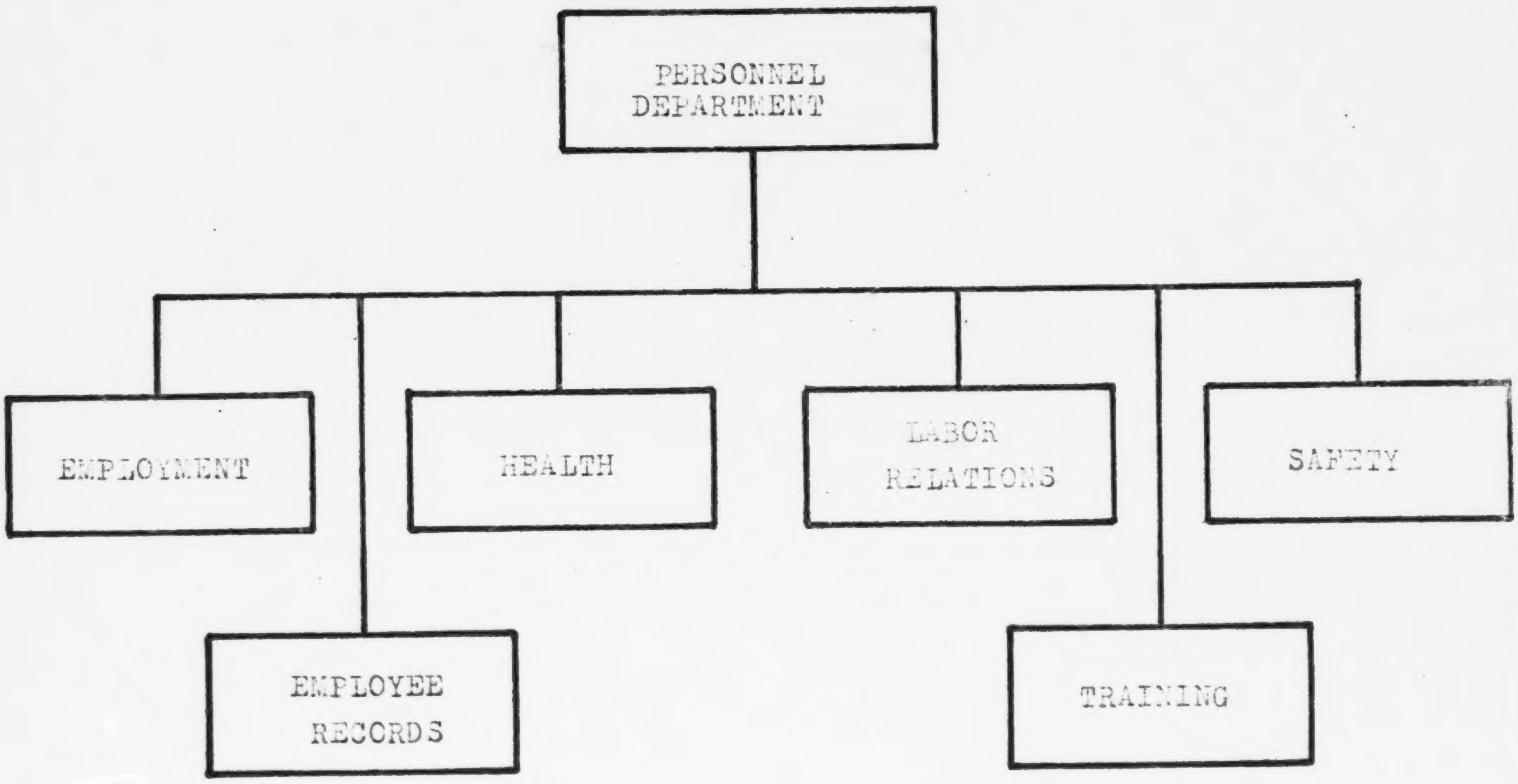
5) When this discussion is finished, this group will give a brief report to the class. (Explaining what your package is about).

FUNCTIONS:

Employment - The purpose is to maintain an adequate supply of qualified workers. This is done by 1) maintaining adequate sources of recruits, 2) careful selection from those recruited.

Health - Deals with maintaining the good health of employees. This is certainly a factor in having an effective work force.

Labor Relations - Deals with the settlement of employee - employer grievances, and negotiating labor-management contracts.


PERSONNEL DEPARTMENT
EMPLOYMENT
HEALTH
LABOR RELATIONS
SAFETY
EMPLOYEE RECORDS
TRAINING

FUNCTIONS: (Cont'd)

Safety - Is a program usually set up by a safety director to insure safety for the employees. It is a set of rules or safe practices which every one in the corporation must follow.

Training - Deals with the new employee and is concerned with introducing him to his job and to the plant environment.

Employee's Records - Are records of the employee based on his past performance. These records are used to evaluate the employee.

TEACHER PACKAGE

ORGANIZATION AND MANAGEMENT

THE INITIAL START OF A STUDENT CORPORATION

OBJECTIVE:

The student will select one of the subdivisions in which he will work and place his name on the handout sheets. (Pages 3 & 4) Page 3 consists of spaces for the chairmen and Page 4 consists of spaces for other students who desire to work in that subdivision.

ACTIVITIES:

1) Make transparencies from the master of Pages 3 & 4.

2) Issue handout sheets.

3) Using the transparency of Page 3, have students decide on the chairman of each subdivision.

4) Using the transparency of Page 4, have students decide or select the special area they will work in.

5) Every student will become a stockholder temporarily until the corporation is started. The true stockholders will be those pupils in the class and others who have bought shares.

6) The stockholders will elect a board of directors, or may I suggest that the chairmen of each subdivision become the board of directors.

7) Establish that the stockholders are the owners of the corporation. They have the power to elect the board of directors, sell the assets of the corporation, and to dissolve the corporation.

8) Discuss the responsibilities of the board of directors; they:

a. Elect the officers
b. Make contracts in the name of the corporation
c. Declare dividends
d. Insure corporate stock
e. Determine corporate policies

The board of directors has the final authority in all corporate matters.

9) The board of directors will elect the President, and Vice President.

10) If additional help is needed, the students of a chosen subdivision may research that area.

11) Note: For the initial start, all students should have total involvement in Research and Development--To select and discuss possible products.

12) Once the product is selected, the students then will sell shares and determine the money they need.

13) Finally, each subdivision will carry out its function.

FOR THE STUDENT

No. D-1

RESEARCH AND DEVELOPMENT

LEARNING ABOUT RESEARCH AND DEVELOPMENT

Objectives:

1. To explain correctly in your own words what research and development is.
2. To be able to tell why research and development is done.

Activity:

Listed below are seven questions. After you have answered each question, check your answers on page 3.

1. List several articles about you (about 6), including clothing and furniture.

   ________ ________ ________ ________ ________ ________

2. Did any of these articles listed above create themselves?

   ________________.

3. Would you say that some knowledge of materials was necessary in order to make some of the articles you listed? ____________

4. If some knowledge was necessary, how do you think it was obtained?

   ____

5. Research sometimes is necessary to find out more about materials. We have development when this information is used to make the material useful. So, to find out more about a material we do

   ______________________. Making a material useful is

   called ____________________________.

6. Is there an electric light in the room where you are now?________. If so, why do you think light bulbs were made?

   ________________.

7. To find out about materials that could be used in a light bulb, much ____________________ had to be done. To put the materials together into a useful light bulb, much ____________ had to be done.

Post test:

1. What is research? ______________________________.
2. What is development? ______________________________.
3. Remembering the light bulb, why is research and development done?

   ______________________________.

STUDENT ANSWER SHEET
FOR ACTIVITY QUESTIONS

1. Six articles named by you
2. No
3. Yes
4. Your own answer (through study or research of some kind)
5. Research, development
6. Yes (most likely), light bulbs were made to light the darkness.
7. Research, development

ANSWERS FOR POST TEST

1. Finding out more about materials
2. Making materials useful or better
3. In the case of the light bulb, research and development was done because there was a need for a better light.

FOR THE STUDENT No. D3

RESEARCH & DEVELOPMENT

"HAVING A BRAINSTROMING SESSION"

Objective:

You will:

1. State in your own words that brainstorming is an activity designed to obtain ideas.
2. Participate in a short brainstorming session by orally giving your ideas about a given subject. The subject of this lesson is making a product from a material available in your lab.

Activity:

1. Thread the "brainstorming" tape onto the tape recorder.
2. Turn on the recorder and follow the instructions as given on the tape as it plays.
3. After the tape is finished: rewind the tape, turn off the recorder.
4. Choose your chairman who will then review the rules with you.
5. Install the clean tape and upon direction from the chairman, begin with your own ideas on your own topic.
6. Continue contributing ideas for the agreed amount of time, then stop.
7. Replay for evaluation and selection of your best ideas.
8. Report your best ideas to your teacher.

Post test:

You must have participated in the brainstorming session.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. D3

Text of tape used for the instruction:

Industry needs many ideas to solve its complex problems. One way of getting these ideas is by a method called brainstorming.

In order to give you an idea of how this works, we will give a sample of a typical session. After this session, you will organize into your own brainstorming group to conduct your own sessions.

First voice is the chairman. We need some ideas on making a product from a material available in our lab that will serve as a gift and yet cost no more than an amount decided on before we begin. The rules we will follow are as follows: 1) we will begin at the sound of the gavel, 2) beginning at my right, we will give our ideas one per person in round-robin fashion, 3) after one round is finished we will give our ideas in random fashion and continue for five minutes or until there are no more ideas, whichever comes first, 4) if confusion begins, the chairman has the right to restore order by striking the gavel.

The tape recorder will be used all during this session to record all ideas. Later it will be replayed to evaluate the many ideas offered.

Chairman on tape begins the session and it runs for about one minute with several ideas being presented. Chairman ends the presentation and calls for the replay so the ideas can be heard again and evaluated. (Ideas will not be replayed on the demonstration tape but students understand that this is what they will do with their own).

Now you are ready to begin with your own brainstorming session.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

EVALUATING POSSIBLE PRODUCTS

Objective:

Given the type of product as decided from a brainstorming session (see package D-2, Having a Brainstorming Session) you will compare the good and bad qualities of several product ideas of that type. For example: if the type of product chosen is furniture, then your group will evaluate lamps, tables, chairs, cabinets, etc.

Pre-requisites:

A type of product must be previously decided upon.

Activity:

1. Select a chairman within your Research and Development group who will lead you through rest of the activity.
2. Again use the package, Having a Brainstorming Session, package D-2, to decide upon four to six specific objects of the type previously chosen to evaluate.
3. Refer to the guide on page 2 of this package for examples of qualities to evaluate.
4. Using the analysis sheet on page 3 of this package as a model, one person (appointed by the chairman) will fill in the information about the products as decided by the group.

Post test:

You will have participated in the evaluation of products by examining the desirable and undesirable qualities and listing them on the analysis sheet.

GUIDE FOR QUALITIES TO BE EVALUATED

Is product useful?

Appearance of product

How easily can it be used?

Are materials durable enough?

Cost: reasonable?

weight: too heavy, too light?

Other items you may want to evaluate

Can we perform needed processes in our lab?

How long will it take to make?

ANALYSIS SHEET

Product Name	Desirable Qualities	Undesirable Qualities

TEACHER PACKAGE

No. D-4

RESEARCH AND DEVELOPMENT

SELECTING THE PRODUCT

Objective:

Given an analysis sheet listing the desirable and undesirable qualities of a variety of products, the students will select one product to manufacture.

Prerequisites:

The Research and Development team should have the analysis sheets ready which were prepared in packages D-3. Evaluating Possible Products. The Research and Development team also may have one or two recommendations prepared.

Activity:

1. The entire class should have an opportunity to review the contents of the analysis sheets. Handouts can be used or an overhead transparency of the analysis sheet can be prepared and used for the entire class to view.
2. A recommendation should be asked for from the Research and Development team that conducted the original evaluation of possible products.
3. Discussion should be permitted under the direction of the teacher. The teacher may also recommend or suggest according to his judgments.
4. A final selection should be made in order for the Research and Development team to prepare a request for the Planning for Production committee to construct a prototype or model.

TEACHER PACKAGE

No. D-5

RESEARCH AND DEVELOPMENT

PRESENTING THE PRODUCT

Objective:

The entire class will examine the product to determine any necessary changes.

Prerequisite:

The product must have been previously selected for production by the class (package #D-4, Selecting the Product).

Activity:

1. The Research and Development committee will present the proto type, model, or drawings of the product prepared by the Planning for Production committee.
2. Discussion of good and bad features should be encouraged by the teacher.
3. The class should come to final agreement about any modifications needed to improve the product.
4. Agreed modifications will be noted by the Research and Development committee.
5. The product may now be returned to the Planning for Production committee for further development.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

STUDYING COMPETITIVE PRODUCTS

Objective:

1. Given one or more products similar to the one you are considering for manufacture, you will examine each product, including your own, and prepare a chart which compares the good and bad points of both yours and the competitive products. You will then suggest ways to improve your own product.

Pre-requisite:

Have ready one or more competitive products to compare to your own ready for this session.

Activity:

Other products like yours or almost like yours in many ways can be called competitive products. Yours probably can become just as good or better than the competitive articles if you study them to find all of their good and bad points. Then make your product the best of them all.

1. Select a chairman for your Research and Development group who will guide you through the activity.
2. Your Research and Development group will examine each product (yours and competitive ones) making sure to check things like appearance, materials, function, durability, and selling price. (include any other points you feel are important).
3. Make a chart like the sample included with this lesson to compare all of the good and bad aspects of each product you examine.

Post-test:

Suggest ways of improving your own product so that it will be as good or better than its competitors. Make a list of these suggestions and turn them into your instructor.

COMPARISON CHART

	Looks: color, shape, weight, etc.	Parts: strong, weak, etc.	Special Features	Price
Competitive Product #1	attractive green color	handle bends too much	none	$2.60
Competitive Product #2	Light weight, pleasing design	all strong parts	has special compartment for spare bulb	$3.15
Competitive Product #3				
Competitive Product #4				
Competitive Product #5				
Your Own Product				

FOR THE STUDENT

No. D-7

RESEARCH AND DEVELOPMENT

DETERMINING THE SIZE OF POSSIBLE MARKET

Objective:

Given a list of questionnaire guidelines, you will construct a survey questionnaire.

Activity:

Take a sheet of paper and follow the listed steps in developing a survey:

1. form a committee of not more than six class members.
2. sit in a quiet area.
3. use the attached sheet and make questions that will follow the guideline.

Post test:

You will submit a completed survey questionnaire to the teacher for evaluation.

QUESTIONNAIRE GUIDELINE SHEET

You should develop questions that are similar to those listed below. As an example, the questions stated below have been developed to determine the market evaluation for a desk lamp. Develop similar questions for the product you are making.

Some Guidelines to Follow:

You must know your product (what it will do, and what it will not do).

Remember that the questionnaire stated below is not "the" questions but "some" questions that could be used in'developing a questionnaire.

You must ask enough questions to gather the information you want.

Do not ask any more questions than needed.

THE QUESTIONNAIRE

1. Do you own a lamp? _______ _______
   yes no

2. How many lamps do you own? __________

3. Do you own a desk lamp? _______ _______
   yes no

   a. If the answer to the question is no, how much would you be willing to pay for a lamp?

      _______ under $3.00
      _______ $3.00 - $5.00
      _______ $5.00 -$10.00
      _______ above $10.00

   b. If the answer is yes, would you be willing to buy another lamp? _______ _______
      yes no

4. What kind of material would you prefer the lamp base to be made of? Please number 1, 2, and 3 in order of your preference.

   _______ wood
   _______ metal
   _______ other ____________
   specify

5. What category of height would you prefer.

    1. _______ Low (below 10")
    2. _______ Medium (10"— 15")
    3. _______ Tall (above 15")

6. In order of preference, what color would you prefer the lamp shade to be?

    1. _______ Clear
    2. _______ White
    3. _______ Other _______________ specify

7. Would you prefer a three-way switch over the regular one-way switch? __________ yes __________ no

8. Other comments ____

____

____

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

RESEARCHING THE PATENT LAW FOR YOUR PRODUCT

Objective:

Given the name of your product model, its design specifications, and performance requirements, you will use the library to check for possible patents that may already exist for this product.

Activity:

1. Select a committee of approximately five students.
2. Go to the library.
3. Look in the section marked technical documents.
4. Ask your librarian for help in finding the manual of classification of patents.
5. Examine the patent references to determine whether design or invention rights for your product have already been granted to another person.
6. If the answer is yes, do not pursue a patent.
7. If the answer is no, ask the teacher to work with you on teacher package number D-9.
8. Submit findings to your teacher.

Note:

Researching a patent involves long hours of work. If time and/or knowledge is a factor in your understanding of how to research a patent, you may hire the services of a patent lawyer.

FOR THE TEACHER

RESEARCH AND DEVELOPMENT

INVESTIGATING FEDERAL, STATE AND LOCAL RESTRICTIONS THAT MAY AFFECT THE MANUFACTURING OF YOUR PRODUCT

Objective:

Given proper aid (Social Studies and English departments) the student will write a letter of application to Washington, D.C. and check for manufacturing restrictions that may exist regarding the product.

This is a follow-up for student package number D-8. After discovering that no patent exists for your experimental product, the next step would be to apply for a patent in Washington, D.C. and write a letter to the state or local level of government inquiring about the restrictions that may exist on your experimental product.

This is an excellent opportunity to work with other areas outside of Industrial Arts; especially the Social Studies and English departments. The English department can greatly assist in designing a letter of application to the patent office in Washington, D.C., and checking for governmental restrictions at the state or local level by writing a letter or preparing an interview.

It might be helpful to use the Social Studies department to assist as a patent lawyer and help determine the kinds of restrictions that may be expected in manufacturing your product.

FOR THE STUDENT

D-11

RESEARCH AND DEVELOPMENT

STUDYING FUNCTIONAL REQUIREMENTS

Objective:

Given the product selected in package D-4, Selecting The Product, you will determine what functions (jobs or uses) this product should have, and list them. The list of functional requirements will be forwarded to the Planning For Production committee for their use in designing the prototype.

Prerequisite:

Package D-4, Selecting The Product, must be completed before doing this package.

Activity:

1. Select one person in your group who will act as the recorder for writing your list of recommended functions.
2. Begin by asking yourselves: "What is the purpose of this product?" List the purposes. (See the student information sheet on the next page for more explanation).
3. Next, ask yourselves what this product must do in order to meet its purposes. List these also. These will be the functions.
4. Turn in your list to your instructor for review so that it can be forwarded to the Planning For Production committee for their use on the prototype.

Purposes of your product

1. ______________________________
2. ______________________________
3. ______________________________

Functions of your product

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

STUDENT INFORMATION SHEET

As an example, suppose your product is to be a book rack.

For step #2 of the activity you would list:

Purposes of your product

1. To display the books safely so they can be easily seen and selected.
2. To prolong the life of the books by proper storage.

Then, list the things your product must do in order to meet its purposes. These would be the functions.

Functions of your product

1. Securely hold all volumes of the collection of books.
2. To show the backs of each book vertically in order to quickly select the desired books.
3. To have some means of expansion to accomodate other books to be added.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

DETERMINING MATERIAL REQUIREMENTS

Objective:

Given the product selected in package D-4 and the functional requirements determined in package D-11 you will determine materials required for your product.

Prerequisite:

Packages D-4 and D-11 must be completed before beginning this package.

Activity:

1. Construct a Functions and Materials chart like the sample shown on the next page of this package.
2. List the product parts and the corresponding functions in their columns.
3. As shown in the sample, determine suitable materials that will allow the parts to function properly.
4. If you are not sure which materials would work best for a particular function, list more than one material.
5. Show your chart to your teacher for examination so that it can be forwarded to the Planning For Production committee which is working on the prototype.

SAMPLE FUNCTIONS & MATERIALS CHART

Product: Picture frame

Product Part	Part Function	Materials Required
Glass or clear plexiglass	Protects picture from damage	Thin glass or plexiglass
Frame	Holds picture and glass in place	Wood molding
Backing for picture and glass	Holds glass and picture in frame molding. Also provides notch for hanging picture on wall and a prop for displaying the picture on a desk top.	Heavy cardboard
Miscellaneous materials	To hold frame together	Glue and small nails if desired
	To preserve and beautify the wooden frame	Stain and varnish

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

DETERMINING VISUAL REQUIREMENTS

Objective:

Given the product from package D-4, and having determined the material requirements in package D-12 and the functional requirements in package D-11, you will sketch the visual requirements for the product which will be forwarded to the design department of the Planning For Production Committee.

Prerequisites:

Packages D-4, D11, and D-12 must be completed before performing this package. You must also have some skills in rough sketching of objects such as done in drafting or art classes.

Activity:

1. Each member of your group will be supplied with paper and pencil for sketching. See your teacher for such materials if you do not have them.
2. Each member of the group will sketch a pleasing design of the product while keeping in mind the functional and material requirements of the product.
3. When every member is finished with his sketch a number should be placed on the back of the sketch for identification.
4. One member of the group will take all of the sketches and show them to the class one student at a time to see which sketch each student likes the best.
5. A record shold be kept to see which sketch is most prefered by the class members.
6. The sketch most liked will be turned over to the instructor for examination and then relayed to the Design Department of the Planning for Production Committee for further refinements.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

FINDING THE COST OF PRODUCTION

Objective:

Given the name of the product (package D-4), the materials required (package D-12), a materials price list, and estimates of labor costs for the various manufacturing operations (packages E-34 through E-36 in Planning For Production and Manufacturing Operations), you will determine the cost of manufacturing the product as closely as possible.
Note: Do not be concerned with costs for electricity, overhead, transportation, etc. for this package.

Prerequisites:

1. You must have completed packages D-4 and D-12.
2. You must be able to add, subtract, multiply and divide whole numbers and decimal fractions.

Activity:

1. Prepare a Cost of Production Chart like the one shown with this package.

   For the following steps 2 through 9 refer to the sample Cost of Production Chart shown in this package.

2. Using the Functions and Materials Chart from package D-12 as a guide, enter all the part names of your product in column 1 as shown in the example with this package.
3. Also using the Functions and Materials Chart from package D-12 as a guide, enter the materials needed for each part in column 2 as shown in the example with this package.
4. In column 3 list the quantities of material needed.
5. In column 4 enter the price per board foot, pound, square yard, etc. for each material.
6. In column 5 find the cost of materials by multiplying each item in column 3 by its corresponding item in column 4.
7. In column 6 enter the cost of labor for each part from information received from the Planning For Production and Manufacturing Operations group.
8. In column 7 find the total production cost for the part by adding each figure in column 5 to its corresponding figure in column 6.

Activity (cont'd):

9. To find the complete cost of manufacturing add together all figures in column 7 only.

10. Turn in your completed chart to your teacher for examination.

COST OF PRODUCTION CHART

D-15

Product: Picture frame, 9" x 12"

1	2	3	4	5	6	7
Part	Kind of material required	Quantity of material	Price of material per unit	Material cost (col 3 x col 4)	Cost of labor to process (Plan for Production Dept.)	Total production cost for part (col 5 + col 6)
protective shield for picture	glass 9" x 12"	1	$0.15	$0.15	$0.00	$0.15
frame	wood molding	42"	½-cent per inch	0.21	0.20	.41
backing	cardboard 9" x 12"	1	.02	.02	.05	.07
miscellaneous materials	nails glue stain varnish	1 pkg	.10	.10	.20	.30
					complete cost	$0.93

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

CORRECTING PRODUCT DEFICIENCIES

Objective:

Given an improperly functioning product from your pilot assembly line which cannot be corrected by changes made by the Production or Manufacturing Department, you will research the problem to find the cause of malfunction and, if necessary, experiment with new materials or designs for the product to overcome the deficiency.

Activity:

If a product will not work properly, or does not look like it is supposed to, it is deficient. If the deficiency cannot be corrected by the Production or Manufacturing Department, then the product is deficient in its material or design. This is why you are now called upon to solve the problem. The following steps should help detect and correct the deficiency.

Not all steps are necessarily needed. You might solve the problem in the first step or you may need to use all of the steps, depending upon the problem.

1. Find out, by looking at the product, whether the fault lies in the design or the materials.
2. If looking over the product doesn't help, and parts are broken, then try different materials in place of those that failed.
3. If new materials continue to fail, then begin to change the design in some way to eliminate failure.
4. If no parts break or bend, and the product still will not work, then the deficiency more than likely is with the design. This would also mean a need for a design change.
5. Continue experimenting until you feel you have a reasonable answer.

Post test:

If you have successfully corrected the product deficiency you have met the objective of this package.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

SELECTING THE BEST PROCESSES

Objective:

Given your product, the number of units you will be producing, the possible materials from which the product is to be made, and the procedures involved in making this product, you will select at least one process to use for each step of production.

Activity:

1. Go step by step from list developed in package number D-18
2. Select teams.
3. Go over each step and list all possible processes you can think of for each step.
4. Step by step decide on the best process by considering:
   a. safety
   b. tool and materials
   c. time
   d. set-ups required
   e. cost (materials and labor)
   f. waste
5. Prepare list.
6. Make sample using every process listed.
   a. Do they work?
   b. Can they be set to work in production quickly, accurately and cheaply?
7. If yes, give list to teacher.
8. If no, decide on an alternate process.

Sample Process Chart for a Coffee Table

Procedure	Procedure Performed	SUGGESTED PROCESSES		
		Process	Advantages	Disadvantages
# 1	Lay out stock	Scribe		
# 2	Turn Legs	Wood Turning	Multiple Design Smooth Finish	
# 3	Assemble Top	Gluing	Strength	
		Clamping	"	
		Nailing		Looks Marked
		Screws		" "
		Dowels	High Strength	
# 4	Attach Legs	Screws	High Strength	
		Dowel, Glue		Low Strength
Etc.				

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

DETERMINING THE PROCEDURES IN MAKING YOUR PRODUCT

Objective:

Given your product, the number of units you will be producing, and the material from which the product is to be made, you will specify the procedures involved in making this product.

Activity:

1. Select four teams with three students on each team.
2. Get materials, plans, and tools.
3. Have one person make the product while the other two watch and write down every step.
4. All teams get together, compare notes and develop a master list, with alternate routes.
5. All four "makers" make one more model and assemble the master list of steps.

Post Test:

Give procedures to the teacher for approval.

Note:

Attached is a sample procedure chart that could be used as a possible format.

Sample Procedure Chart for a Wood Coffee Table

Procedure	Procedure Performed	Materials Used	Tools Used	Notes
# 1	Turn Legs	Wood	Wood Lathe & Turning Tools	
# 2	Assemble Top	Wood, Glue	Clamps	
# 3	Attach Legs	Screws, Glue	Countersink, Screwdriver	
# 4	Sand Project	Abrasive Paper	Sander	Sand Legs on Lathe
# 5	Apply Finish	Stain, Lacquer Steel Wool, etc.	Brush	
Etc.				

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

CHOOSING NEW PROCESSES

Objective:

Given an improperly functioning process from your pilot assembly line, which cannot be changed by the Production of Manufacturing Department, you will research the problem to find the cause of process deficiency and, if necessary, experiment with new methods to develop a new process.

Activity:

If a process deficiency report is received from the Production and Manufacturing Department stating the chosen process does not work, an alternate process must be selected.

However, in some instances an alternate process may not correct the fault. In that situation, a new process may need to be developed.

Below are a list of steps that will help discover a new process or correct the process deficiency.

1. Find out by looking at the process, whether the fault lies in the design or the process.
2. If looking over the process doesn't help, then try different processes in place of those that failed.
3. If different processes still will not work, the deficiency, more than likely is in the design..
4. Change the design in some way to eliminate failure.
5. Continue experimenting until you have a reasonable answer.

Post Test:

If your new process is successful,you have met the objective of this package.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

CORRECTING THE PROCESSES CHOSEN

Objective:

Having received a process rejection report from the Planning for Production and Manufacturing Department, you will select an alternate process for your product.

Prerequisites:

This package is not to be used unless the Research and Development Department has received a process rejection report from the Planning for Production and Manufacturing Department.

You must have previously completed packages D-17, D-18 and D-20.

Activity:

1. Assign the responsibility of listing the reasons for the rejection of the process to three members of your team. (use the process rejection report received from the Planning for Production and Manufacturing Department)

2. Assign three members of the team the responsibility of locating and collecting all information which was used in selecting the process. (packages D-17, D-18 and D-20)

3. Hold a committee meeting to discuss the reasons why the process was rejected and the information which was used to select this process. (Have all the information available at the committee meeting and ask members of the Planning for Production and Manufacturing Department to attend)

4. Select an alternate process using the information which results from the committee meeting. (The committee may suggest that the process research team select an alternate process by using the process research packages a second time.

5. **Give the selected process to the Planning for Production and Manufacturing Department.**

RESEARCH AND DEVELOPMENT

DETERMINING POSSIBLE MATERIALS

Objective:

Given an opportunity to view and discuss the film "Plastic Shells and How They are Made", you will see the unique methods which can be applied in testing materials for a product.

Given an opportunity to view and discuss the film "Plastic Shells and How They are Made", you will select possible materials for your product.

Activity:

1. Select a committee to serve as the materials research team.
2. Elect a materials research executive to lead the materials research team.
3. The materials research executive and the instructor will arrange for the materials research team to view the film "Plastic Shells and How They are Made".
4. View the film "Plastic Shells and How They are Made".
5. Hold a committee meeting to discuss the film as a basis for selecting materials for your product.

   Suggested topics may be:

   A. What materials are available for our product?

   B. What materials will be attractive for our product?

   C. What materials will aid in good product construction? (consider cost, machinability, finishing, durability, etc.)

   D. What equipment will the material require?
6. Write a list of the possible product materials.
7. Give the list of possible product materials to the materials research executive.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. D-22

Media: 15 minute film

For this package the student will need the film entitled "Plastic Shells and How They are Made".

Source for the film
Remington Arms Company, Inc.
939 Barnum Ave.
Bridgeport, Conn. 06602

Telephone: 203-333-1112

Charges
Return postage plus insurance coverage

RESEARCH AND DEVELOPMENT

TESTING THE MATERIALS

Objective:

Given an opportunity to view the film "Search", you will describe in writing three scientific tests used for testing materials for a product.

Given an opportunity to view the film "Search", and discuss the demonstrated tests, you will choose scientific tests for testing your product's materials.

Prerequisite:

You should have completed package D-22 (Determining Possible Materials).

Activity:

1. The materials research executive and the instructor will arrange for the materials research team to view the film "Search".
2. View the film "Search".
3. Each team member will list at least three scientific tests demonstrated in the film.
4. Hold a materials research committee meeting to discuss the film.

   Suggested topics for discussion

   A. Are any of the demonstrated tests useful to our team?

   B. Can we adapt any of the tests for our possible materials?

   C. What tests can we design for testing our product's materials?

5. Design tests which you can apply for your product's possible materials.
6. Give the materials research executive the tests which you designed.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. D-23

Media: 22 minute film

For this package the student will need:
the film entitled "Search"

Source for the film
General Motors Corporation
Public Relations Staff-Film Library
General Motors Building
Detroit, Michigan 48202

Telephone: 313-556-5000-8551

Charges
Return postage plus insurance coverage

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

FINDING THE PROPERTIES OF MATERIALS

Objective:

Given a list of possible product materials and packages D-25 through D-29, you will select and perform tests which will give data for the listed materials.

Prerequisite:

You should have completed package D-22 (Determining Possible Materials) and have packages D-25 through D-29 (Tests for Finding the Properties of Materials) available.

Activity:

1. Get the list of possible product materials from the materials research executive.
2. Get packages D-25 through D-29 from the teacher.
3. Read packages D-25 through D-29.
4. Select the packages which will give you the desired data.
5. Using the selected packages, perform the described tests.
6. Give the test results to the materials research executive.

RESEARCH AND DEVELOPMENT

TESTS FOR FINDING THE PROPERTIES OF MATERIALS

HARDNESS AND TOUGHNESS

Objective:

Given a piece of material, you will perform tests concerning the material's hardness and toughness, and report your results by writing a report.

Prerequisite:

You should have package D-24, Finding the Properties of Materials, to use in submitting your results.

Activity:

1. Read the definitions for the terms, hardness and toughness. (page three)
2. Make a copy of the chart for material hardness. (page 4)
3. Test the material for hardness by performing two of the suggested hardness tests. Use the same tests for each material so that you may compare the results.
    - a. Rockwell Hardness test
    - b. Brinell Hardness test
    - c. Scratching
      Scratch the materials with a scribe.
    - d. Drilling
      Drill a hole in the materials with a drill bit.
    - e. Cutting
      Cut the material with a hand shears.
    - f. Striking
      Strike the material with the peen end of a ball peen hammer.
    - g. Materials Hardness Chart
      These can be found in most catalogs describing the various materials.
4. Write two short sentences which state your results concerning the hardness of the material.

5. Make a copy of the chart for material toughness. (page 5)

6. Test the material for toughness by performing one of the suggested toughness tests. Use the same test for each material so that you may compare the results.

   a. Charpy test
   b. Izod test
   c. Notching
      Notch a small piece of material on one side, place the material in a vise and strike it with a hammer on the notched side.
   d. Striking
      Place a small piece of material in a vise and strike it with a hammer.
   e. Striking on a solid surface
      Place a small piece of material on a solid surface and strike it with a hammer.

7. Write two short sentences which state your results concerning the toughness of the material.

8. Refer to package D-24, Finding the Properties of Materials, step number 6.

STUDENT REFERENCE SHEET FOR PACKAGE D-25

Hardness - that property of a material that enables it to resist plastic deformation, penetration, indentation, or scratching

the capacity of the surface of a material to scratch another material, or to be scratched itself

resistance to wear generally increases with hardness

Toughness - that property of a material that enables it to react under sudden impact

the ability of a material to endure strain

(Note: you must understand all the terms used to define these properties. You may have to refer to a dictionary to gain this knowledge.)

CHART FOR MATERIAL HARDNESS

Material	Test Used	Description of Results
1 Aluminum 19 Gauge	A Scratching	Easy to scratch with deep mark left
Steel 19 Gauge	B Scratching	Hard to scratch with little depth of scratch
2	A	
	B	
3	A	
	B	
4	A	
	B	

CHART FOR MATERIAL TOUGHNESS

Material	Test Used	Description of Results
1 Aluminum	Notching	Did not break but bent over
2 Steel 19 gauge	Notching	Broke off at the notch
3		
4		
5		

FOR THE STUDENT No. D-26

RESEARCH AND DEVELOPMENT

TESTS FOR FINDING THE PROPERTIES OF MATERIALS

WORKABILITY

Objective:

Given a piece of material, you will perform activities relating to the material's workability and record your findings on a material workability chart.

Prerequisite:

You should have package D-24, Finding the Properties of Materials, to use in submitting your results.

Activity:

1. Read the definition for the term workability. (page 3)
2. Determine the operations which will be necessary in the construction of your product. (see package D-17, Selecting Best Processes)
3. Make a copy of the Material Workability Chart. (page 4)
4. Select tests from the suggested tests which will provide information concerning the material's workability. Select only those tests which will provide information required for the construction of your product.

Formability - perform any operations required in the construction of your product which require the material to be bent, folded, stretched, drawn or hammered by using such equipment as the bar folder, box brake, vacuum press, arbor press, vise, anvil, ball peen hammer, etc.

Castability - perform any casting operations which your product requires to be sure the selected material has the ability to form the desired casting.

Machinability - perform any material removal operations which your product requires, such as, drilling, turning, threading, sanding, filing, sawing, reaming, grinding, etc.

Joining - construct samples of each joint which is required in the construction of your product. Use various methods of joining the samples, such as, riveting, soldering, welding, nailing, gluing, sewing, bolting, etc.

Finishing - prepare samples of various finishing methods, such as:

A. Painting
  1. Spraying
  2. Brushing
  3. Dipping
  4. Stenciling

B. Machining
  1. Polishing
  2. Buffing
  3. Knurling

C. Coating
  1. Taping
  2. Spraying
  3. Laminating

5. Perform the selected tests.

6. Complete the Material Workability Chart.

7. Refer to package D-24, Finding the Properties of Materials, step number 6.

STUDENT REFERENCE SHEET FOR PACKAGE D-26

Workability - that property of a material that enables it to be formed, machined, joined, finished, cast, or cut until a completed product results.

Material Workability Chart		
Material	Test	Description of Results
Copper 20 Gauge	Formability	A folded seam was easy to construct
Galvanized Steel 20 Gauge	Formability	A folded seam can be made

No. D-27

RESEARCH AND DEVELOPMENT

TESTS FOR FINDING THE PROPERTIES OF MATERIALS

STRENGTH

Objective:

Given a piece of material, you will perform tests relating to the material's tensile strength and ductility and then record your findings on a strength of materials chart.

Prerequisite:

You should have package D-24, Finding the Properties of Materials, to use in submitting your results.

Activity:

1. Read carefully the descriptions of and definitions for strength, tensile strength, and ductility on page three.
2. Make a copy of the Strength of Materials chart for recording your results. (page four)
3. Make two small test samples of each material to be tested. Samples must be small.
4. Test each material by using two of the suggested tests.

   A. Tensile Strength

      1. Stretching
         Using a hydraulic press or hydraulic jack for a force, apply enough load to break the material sample.

   B. Ductility

      1. Stretching
         Using a hydraulic press or a hydraulic jack for a force apply enough load to deform each material sample.

2. Hammering
Using a ball peen hammer and an anvil, strike each material sample fifty times in the same general area.

3. Bending
Bend each material sample to a 90° angle and then straighten it as many times as is necessary to break the sample. (Be sure to count the times.)

STUDENT INFORMATION SHEET FOR PACKAGE D-27

Strength - is the term used in determining how much force a material will take without breaking, and how much it will change in shape and size when an outside force is applied. This term involves both a material's tensile strength and its ductility.

Tensile strength - is the measure of the maximum force a material will stand without being pulled apart or yeilding in shape to more than an acceptable standard.

Ductility - is the ability of a material to withstand being deformed without breaking. Also ductility may be thought of in terms of bendability and crushability. The lack of ductility is called brittleness.

Strength of Materials Chart		
Material	Test Used	Description of Results
Copper 18 Gauge	Ductility	Deforms very easily
Copper 18 Gauge	Tensile Strength	Stretches easily with a small load

FOR THE STUDENT No. D-28

RESEARCH AND DEVELOPMENT

TESTS FOR FINDING THE PROPERTIES OF MATERIALS

WEAR OR DECAY

Objective:

Given a piece of material, you will perform tests relating to the materials ability to withstand wear or decay and record your findings on a Materials Wear or Decay chart.

Prerequisite:

You should have package D-24, Finding the Properties of Materials, to use in submitting your results.

Activity:

1. Read carefully the descriptions and definition for the terms wear and decay. (page 2)
2. Make a copy of the Materials Wear and Decay Chart. (page 3)
3. Make small test samples of each material to be tested.
4. Test each material by using one or both of the suggested tests:

   A. Wear

   Use each material sample in a controlled situation which will cause excessive wear in a short period of time. (Example: opening and closing a door 1,000 times as quickly as possible, rubbing material surfaces together faster than the product will require.)

   B. Decay

   Expose each material sample to a controlled situation in which the product requires the material to function. (Examples: excessive heat, excessive cold, excessive sun, excessive moisture, etc.)

5. Record your tests on the Materials Wear and Decay Chart.
6. Refer to package D-24, Finding the Properties of Materials, step number 6.

STUDENT INFORMATION SHEET FOR PACKAGE D-28

Wear - to impair, waste or diminish by continued rubbing, scraping, or other friction producing elements.

Decay - changing from a state of soundness to a state of breaking down, due to spoiling, rotting, disintegration, crumbling, decomposing, etc.

Materials Wear and Decay Chart

Material	Test Used	Description of Results
Wood 1" walnut	Decay	Stains and discolors easily from excessive moisture
Wood 1" Oak	Wear	Very resistive to wear caused by friction

FOR THE STUDENT No. D-29

RESEARCH AND DEVELOPMENT

TESTS FOR FINDING THE PROPERTIES OF MATERIALS

COMPRESSION

Objective:

Given a small sample of material, you will perform tests to determine the pressure required to crush the material and then report your results.

Prerequisite:

You should have package D-24, Finding the Properties of Materials, to use in submitting your results.

Activity:

1. Read the definition for the term compression. (page 3)
2. Make small test samples of each material to be tested.
3. Make a copy of the Materials Compression Chart. (page 4)
4. Select one of the suggested compression tests and test each material for its compressive resistance. (Note: The teacher MUST approve all compression tests for safety.)
   - A. Hydraulic Press
     Place the small sample of material in the press and apply enough pressure to crush the material.
   - B. Arbor Press
     Place the small sample of material in the press and apply enough pressure to crush the material.
   - C. Vise
     Place the small sample of material in a machinists vise and apply enough pressure to crush the material.
5. Write two short sentences stating your results for each material tested.

6. Refer to package D-24, Finding the Properties of Materials, step number 6.

STUDENT REFERENCE SHEET FOR PACKAGE D-29

Compression - that property of a material that enables it to withstand forces acting upon it in a pressing or crushing manner.

Materials Compression Chart		
Material	Test Used	Description of Results
Wood ½" pine	Compression	Failed with a small load
Wood ½" oak	Compression	Failed, but withstood a large load

FOR THE STUDENT No.D-30

RESEARCH AND DEVELOPMENT

CONSIDERING COST OF MATERIALS

Objective:

Given a list of possible product materials, you will complete a cost analysis form for each of the listed materials.

Prerequisite:

You must have completed package D-22, Determining Possible Materials, before preparing a cost analysis.

Activity:

1. Select two team members to prepare the cost analysis.

2. Secure a list of the possible product materials from the materials research executive. (package D-22)

3. Make a copy of the material cost analysis form (see page 2).

4. Secure the required information to complete the material cost analysis form, using more than one source for each material.

   Suggested sources of information:
   A. Retail stores
   B. Wholesale outlets
   C. Catalogs
   D. Manufacturers
   E. Salesmen
   F. Teacher

5. Complete the cost analysis form. (Note: this form will be presented as important data in selecting the material for manufacturing the product.)

6. Give the completed form to the materials research executive.

Material Cost Analysis Form

Name of Material	Description of Material	Unit of Measurement	Price per Unit	Source of Information	Transportation Charge	Company's Name	Discount Available	Taxes		
								Fed	State	Local
Wood	1" Pine	Board Feet	$ .65	Ajax Lumber Co. Catalog	$15.00 per 1000 Bd.Ft.	Ajax Lumber Co.	2% if paid in 30 days	None	3%	None

RESEARCH AND DEVELOPMENT

DETERMINING THE AVAILABILITY OF MATERIALS

Objective:

Given a list of possible product materials, you will prepare a written report describing the availability for each of the listed materials.

Prerequisite:

Package D-22, Determining Possible Materials, must have been completed and the results must be available.

Activity:

1. Select one team member to write a materials availability report.

2. Secure a list of the possible product materials from the materials research executive.

3. Select three possible vendors, suppliers of materials, for supplying the necessary materials.

   Possible sources for vendors names
   - A. Cost analysis team
   - B. Telephone directory (yellow pages)
   - C. Catalogs
   - D. Library
   - E. Retail stores
   - F. Wholesalers
   - G. Teacher

4. Prepare a list of questions which will provide the following information:
   - A. Vendor's name
   - B. Vendor's address
   - C. The materials each vendor can supply
   - D. Length of time between order placement and delivery
   - E. Method of transportation

5. Contact (telephone or write) vendors to answer ques- prepared in step 4.

6. Write a materials availability report which answers the questions in step number four. (Note: this report

will be presented as important data in selecting the material for manufacturing the product.)

7. Give the report to the materials research executive.

RESEARCH AND DEVELOPMENT

SELECTING BEST MATERIALS

Objective:

Given a list of possible materials for your product, (package D-22), a list of the characteristics for these materials, (packages D-24-D-29), a cost analysis for these materials, (package D-30), and a material availability report, (package D-31), you will select the best material to be used in manufacturing the product.

Prerequisite:

You must have completed packages D-22 through D-31 before attempting this package.

Activity:

1. Assign one member to each of the completed packages, numbers D-22 through D-31, with the responsibility of writing a list of important facts about the package.
2. Hold a committee meeting to discuss the results of each completed package from D-22 through D-31. Allow each team member to present the facts concerning his assigned package.
3. Discuss the information presented and allow time for questions.
4. Select the best product material using the information presented and discussed by the committee.
5. Give the selected product material to the Planning for Production and Manufacturing Department.

FOR THE STUDENT

RESEARCH AND DEVELOPMENT

CORRECTING THE MATERIALS CHOSEN

Objective:

Having received a materials rejection report from the Planning for Production and Manufacturing Department, you will select an alternate material for your product.

Prerequisites:

This package is not to be used unless the Research and Development Department has received a materials rejection report from the Planning for Production and Manufacturing Department.

You must have previously completed packages D-22 through D-32, and the results from these packages must be available.

Activity:

1. Assign the responsibility of listing the reasons for the rejection of the product material to two members of your team. (Use the materials rejection report received from the Planning for Production and Manufacturing Department.)
2. Assign two members of the team the responsibility of locating and collecting all information which was used in selecting the product material. (Use the results from packages D-22 through D-32.)
3. Hold a committee meeting to discuss the reasons why the product material was rejected and the information which was used to select this material. (Have all the information available at the committee meeting and ask members of the Planning for Production and Manufacturing Department to attend.)
4. Select an alternate product material using the information which results from the committee meeting. (The committee may suggest that the materials research team select an alternate product material by using the materials research packages a second time

5. Give the selected product material to the Planning for Production and Manufacturing Department.

FOR THE STUDENT No. D-34

RESEARCH AND DEVELOPMENT

CONDUCTING MARKET RESEARCH

Objective:

1. You will select a sales analysis team who will have the responsibility of conducting market research for your product.

2. The sales analysis team will choose a method (or methods) of researching their product's market after reading and discussing packages.

D-35	Designing a Consumer Analysis Form
D-36	Designing a Market Survey
D-37	Gathering Consumer Suggestions
D-38	Analyzing Competition
D-39	Determining Pricing Effects

Activities:

1. Select a committee to become the sales analysis team.

2. Elect a marketing research executive to lead the team.

3. Ask the instructor for packages D-35, D-36, D-37, D-38, and D-39.

4. Read each package very carefully.

5. Discuss the packages in terms of "what do they tell us about a product's market?"

6. Write a list of questions which you would like to answer concerning your product's market.

7. Select the method (or methods) of researching a product's market which best answers your questions. (You have the possibility of adding questions to any of the packages.)

8. Assign team members to conduct the chosen activities.

9. Hold a later meeting to complete package D-40, Collecting Data for Sales Analysis.

FOR THE STUDENT

No. D-35

RESEARCH AND DEVELOPMENT

DESIGNING A CONSUMER ANALYSIS FORM

Objective:

You will design a consumer questionnaire using a format which includes:

1. system of returning forms to the market research department
2. consumer's name
3. date of filling out the form
4. name of the product
5. amount of purchase price
6. date of purchase
7. location of purchase
8. consumer comments

Activity:

Hold a staff meeting of the marketing research committee.

Read the description of a consumer analysis form (Insert #1)

Each committee member designs a sample consumer analysis form.

Select the best consumer analysis form or redesign samples into final copy.

Select a method or system of returning the consumer analysis form to the market research department (Example: self addressed form)

Evaluate the consumer analysis form (Insert #2)

DESCRIPTION OF A CONSUMER ANALYSIS FORM

A consumer analysis form is a sheet which asks questions about the purchase of a product. It is to be filled out by the person who bought the product and then returned to the market research department.

A consumer analysis form provides the marketing staff with a method of collecting sales information. Management uses the information in making decisions about their product.

The form should include such information as: a system of returning the forms to the market research department, consumer's name, date of filling out the form, name of the article, amount of purchase price, date of purchase, location of purchase, and consumer comments.

GUIDE FOR EVALUATION OF A CONSUMER ANALYSIS FORM

1. Does the consumer analysis form include a means of returning the form to the market research department?

2. Does the consumer analysis form include the following?

    consumer's name
    date of filling out the form
    name of the product
    amount of purchase price
    date of purchase
    location of purchase
    consumer comments

3. Does the consumer analysis form include enough space for each response?

4. Does the size of the consumer analysis form present a packaging problem?

RESEARCH AND DEVELOPMENT

DESIGNING A MARKET SURVEY

Objective:

You will design a market survey questionnaire by writing a list of questions which will ask:

1. consumer's name
2. age of consumer
3. sex of consumer
4. how the product will be used
5. how the consumer learned of the product
6. reason for purchase of the product
7. where the product will be used.
8. whether the consumer is satisfied with the product
9. consumer comments

Activity:

1. Select a committee to design the market survey questionnaire.

2. Read the description of a market survey (page 2)

3. Write a list of questions which seek the necessary information.

4. Each committee member should now design a sample market survey form.

5. Select the best form, or redesign samples into final copy.

6. Organize a market survey using the market survey form. (Example: have every third consumer complete the questionnaire).

7. Evaluate the market survey form. (page 3)

DESCRIPTION OF A MARKET SURVEY

A market survey seeks information which will tell management who, and for what purpose their product has been purchased.

This information aids management in making decisions regarding the manufacture of their product. The information must give an accurate account of the possible sales.

The form must include such information as: consumer's name, age of consumer, sex of consumer, how the product will be used, how the consumer learned of the product, reason for purchase of the product, where the product will be used, whether the consumer is satisfied with the product, and consumer comments.

GUIDE FOR EVALUATION OF A MARKET SURVEY FORM

No. D-36

1. Has the form asked for the following?

    consumer's name

    age of consumer

    sex of consumer

    how will the product be used

    how did the consumer learn of the product

    why did the consumer purchase the product

    where will the product be used

    is the consumer satisfied with the product

2. Are the questions easy to understand?
3. Will the answer to the questions aid management in decision making?
4. Will the form be easy to use by the surveyor?

FOR THE STUDENT

No. D-37

RESEARCH AND DEVELOPMENT

GATHERING CONSUMER SUGGESTIONS

Objective:

You will analyze consumer suggestions, using information from the consumer analysis form (package D-35) and/or the market survey (package D-36) to gather suggestions which will aid or call for changes in production or marketing.

Prerequisite:

You should have completed packages D-35 and/or package D-36, conducted your surveys, and have the forms returned with answers on them.

Activities:

1. Assign a committee to list all consumer suggestions which have been written on the consumer analysis form (package D-35) and/or the market survey (package D-36).
2. Read all the consumer suggestions.
3. Choose the consumer suggestions which will aid the sales analysis team in making changes in production or marketing.
4. Give constructive suggestions to the sales analysis team. Examples may be:
    changes in construction (materials, size, etc.)
    additional functions
    greater ease of operation
    ways of more effective advertising
    aids in surveying the market (who, where, how big)

FOR THE STUDENT No. D-38

RESEARCH AND DEVELOPMENT

ANALYZING COMPETITION

Objective:

You will analyze three competitive products by comparing the following factors.

1. materials
2. appearance
3. construction
4. cost
5. ease of operation

Activity:

1. Select a team to analyze competitive products.
2. Select a method of obtaining three competitive products. (approval of instructor is necessary)
3. Read the directions for using the product analysis form.
4. Make a copy of the product analysis form. (page 3.)
5. Obtain three competitive products.
6. Evaluate the competitive products using the product analysis form.
7. Evaluate your product using the product analysis form.
8. Give the results to the sales analysis team.

Directions for Using the Product Analysis Form

1. Place the name of your product in the space provided.

2. Place the name of the competitive products in the spaces provided.

3. Evaluate all products using this point system.

   5. Excellent
   4. Good
   3. Fair
   2. Poor
   1. Not-acceptable

4. Add the points given to each product. (Keep in mind that the product with the highest score might not be the best product. It is also important to note the points given for each factor. For example: A low score on one factor may eliminate the product, even though its total score is highest.)

Product Analysis Form

Name of Product________________________________

Name of Competitive Product #1________________________

Name of Competitive Product #2________________________

Name of Competitive Product #3________________________

Factors to consider	Product #1	Product #2	Product #3	Our Product
Materials Used				
Appearance				
Construction				
Cost Comparison				
Ease of Operation				
Total Points				

FOR THE STUDENT No. D-39

RESEARCH AND DEVELOPMENT

DETERMINING PRICING EFFECTS

Objective:

You will find the effects of a lower price for a product by finding the sales volume differences which result from a special sale price.

Activity:

Choose one of the following two activities which will be better in your situation.

A. Interviewing a Sales Expert

1. Select a committee to choose a possible sales expert to interview.
2. Select the sales expert for the interview. (Example: discount department store sales manager)
3. Contact and make arrangements for interview. (Instructor's approval required)
4. Write a list of questions to ask which will provide information concerning pricing effects. (see sample interview questions on page 3)
5. Visit the expert.
6. Prepare an interview report of pricing effects.
7. Give interview report to the sales analysis team.

B. Conducting a Sale

1. Select a committee to plan a special sale.
2. Determine the product's sale price.
3. Determine the time for the sale. (Example: Saturday 1:00 P.M. - 3:00 P.M.)
4. Determine the location for the sale (instructor's approval necessary)
5. Design and construct several advertisement posters for the sale.

6. Hold the sale.

7. Sale committee will hold a post sale conference.

8. Select a conference secretary to record comments.

9. Discuss the special sale using the following topics:
    1. amount of sales
    2. price reduction
    3. amount of profit
    4. amount of money lost by lower price
    5. consumer price
    6. cost of holding the sale
    7. other topics

10. Give the comments to the sales analysis team.

SAMPLE INTERVIEW QUESTIONS

1. What percentage of price reduction is usually considered in a special sale?

2. What is the most common reason for conducting a special sale?

3. Are special sales held to increase sales volume or to dispose of excess stock?

4. Does advertising result in increased volume for special sales?

5. What is the consumer's reaction to the reduced price in terms of satisfaction?

6. Does the store use special sales as an advertising method?

RESEARCH AND DEVELOPMENT

COLLECTING DATA FOR SALES ANALYSIS

Objective:

Given all the collected market research information, the sales analysis team will prepare a product market research report.

Prerequisite:

You must have completed at least one of the following packages:

D-35	Designing a Consumer Analysis Form
D-36	Designing a Market Survey
D-37	Gathering Consumer Suggestions
D-38	Analyzing Competition
D-39	Determining Pricing Effects

Activities:

1. Hold a meeting of the sales analysis team.

2. Design a class presentation (written or oral) which answers some of the following questions.

   a. Who is buying our product?
   b. Why do they buy our product?
   c. How much are they paying for our product?
   d. How does our product compare with competitive products?
   e. Are our consumers satisfied with our product?
   f. How old are our consumers?
   g. What sex are our consumers?
   h. Where is our product being used?
   i. How can our product be improved?
   j. How did our consumers learn of our product?
   k. Could a lower price result in a better sales volume?

3. Marketing research executive should be prepared to make a class presentation concerning our product's marketing research activities.

RESEARCH AND DEVELOPMENT

PRESENTING THE RESULTS OF MARKET RESEARCH TO THE ENTIRE CORPORATION

Objective:

After listening to the market research report each student will be able to write five sales factors which has affected the sale of their product.

Prerequisite:

You must have completed package D-40, Collecting Data For Sales Analysis.

Activity:

1. Sales analysis team should ask the instructor to allow class time for presenting the market research report to the entire corporation.
2. This team then needs to construct any visual aids needed by the marketing research executive. (Example: posters, charts, graphs, etc.)
3. Review the market research report by writing a list of all the sales factors which will be given in the presentation. (at least eight should be included)
4. Give the market research report.
5. Allow the entire corporation a chance to question the marketing research executive.
6. Pass out paper.
7. Ask each corporation member to write at least five sales factors which have affected the sale of the product.
8. Collect the test papers.
9. Check each corporation member's list of sales factors.
10. Discuss any incorrect sales factors with individual members.
11. Give all test papers to the instructor.

TEACHER PACKAGE

No. E-1

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

EXPLORING THE FIELD OF ENGINEERING

Objective:

Given a list of the various branches of engineering, and a description of the duties of these branches, the student will match the names of the branches with the correct description of duties for each branch.

Activities: (Presentation by Instructor)

Would you like to be an engineer? If so, what would be your area of specialization? Do you know anyone that earns his living as a professional engineer? What does he do? How does a person become an engineer? I am sure that you have thought of these questions at one time or another. The engineer is very important to industry. He is the person that does the planning and calculating. We can define engineering as the profession or life's work, concerned with scientific planning, design, creation, and operation of physical structures -- stationary or moving, large or small, military or civilian. As you can see from the description or definition, the engineer must have a fair knowledge of science and mathematics. If you do well in these subjects, you may wish to consider a career in Engineering.

Some historians say that engineering had it's beginning in the time of Archimedes (287-212 B.C.). This Greek mathematician made large contributions to the science of warfare. The first branch, or specialization of engineering was probably military engineering. From military engineering came the branch of civil engineering. The other branches of engineering we have today came from Civil Engineering. We will now take a brief look at each of the more prominent branches of specialization. As we go through the various branches and you find a particular branch of engineering that is of particular interest to you, let me suggest that you contact your librarian or guidance counselor for additional information. As we describe each of these branches of engineering, try to associate the name with the work that these engineers do.

Aeronautical Engineering -- This branch of engineering is concerned with aircraft, rockets, and space ships. An engineer in this field would solve problems related to travel through air and space. He would work in aircraft design and structures flight testing, pressures in subsonic and supersonic airstreams, and several other interesting problems. The speed of present-day aircraft is measured in Mach numbers. Mach 2 means two times the speed of sound. (Approximate speed of sound is 750 miler per hour.) The space age has opened up many new areas for this branch of engineering.

Agricultural Engineering -- This specialized branch of engineering is concerned with the development, upkeep, and use of agricultural machinery, farm structures, farm power, and soil and water control. This profession had its beginning with man's struggle for existence. Many agricultural engineers search for new methods of producing more food per acre of land, while others search to find ways to combat crop damage caused by insects and disease.

Automotive Engineering -- This branch of engineering is very common today. Almost every family has one car, while several families have two or more cars. The automotive engineers are concerned with developing cars of the future that will be more dependable, more comfortable, cheap to operate, and in recent years a new problem of controlling air pollution caused by the automobile. These engineers are constantly looking for better materials and better methods of making their product.

Chemical Engineering -- Chemical engineering is that branch of engineering concerning the development and application of manufacturing processes in which chemicals or certain physical changes of materials are involved. Chemical engineering has grown out of chemistry. The difference seems to be that while the chemist is doing research with chemicals to establish their content and usefulness, the chemical engineer is applying chemicals and chemical processes to a definite manufacturing application.

Civil Engineering -- This is one of the oldest branches of engineering. Several other branches have broken off from civil to form new areas of specialization. Today we know the civil engineer as a person who designs and builds highways, bridges, canals, and other similar structures. He is known as the "Master Builder". The civil engineer tests various building materials and soil types. The civil engineer must have a good knowledge of surveying which he uses extensively in his work.

Electrical Engineering -- This branch of engineering is concerned with providing electricity for light, heat, power, and communications. Very closely related to electrical engineering are electronics and electronic computers. This branch is the fastest growing branch of engineering today. Electronics serve as the "brains" for all of our automation equipment. More elctrical engineers are engaged in manufacturing enterprises than in any other single field.

Industrial Engineering -- The basic objective of the industrial engineer is to provide the conditions which will permit the completion of a given task in the least possible time and at the lowest total cost, with the least effort, and with the most satisfaction to the people who will do the work. These engineers deal with time and motion study, quality control, production control, budgets, tool design and a host of other jobs. They set the framework for large manufacturing operations.

Mechanical Engineering -- The mechanical engineer is called "the Maker". His job is to design and manufacture the machines used by industry for the transmission and transformation of energy. This is the most broad and varied of all the fields of engineering, serving all industries and supplying the basic working apparatus for each.

There are other branches of engineering with even more specialization than those we have mentioned. These would include ceramics, human, hydraulic, marine, mining, railway, sanitary, structural, and several other branches. If you wish to find information on these areas or branches of engineering, please see your school librarian or guidance counselor.

Now that you have some knowledge of the major branches of engineering, are you ready to make a choice as to which one you prefer? As we have stated, any area of engineering requires a working knowledge of mathematics and science. The first two years of college for the engineering student are about the same regardless of the branch of specialization. These first two years are usually called Pre-engineering. Beyond the first two years the subjects change and relate to a particular branch. Some colleges have four year programs in engineering, but most schools today require five years of study to get a B.S. degree in Engineering. To become a professional engineer one must successfully pass a series of tests. These tests are given by the state in which you intend to work. After you have passed the examinations, you will be issued a certificate which allows you to practice engineering in your state.

Post Test: Name ______________________________

A - Aeronautical Engineering
B - Agricultural Engineering
C - Automotive Engineering
D - Chemical Engineering
E - Civil Engineering
F - Electrical Engineering
G - Industrial Engineering
H - Mechanical Engineering

Match the descriptions which follow with the correct branch of engineering listed above by placing the correct letter in the blank space.

1. ________ the branch of engineering concerned with farm problems.
2. ________ they set the framework for large manufacturing operations.
3. ________ they build highways and bridges.
4. ________ the branch of engineering concerned with airplane design.
5. ________ they are called "the Makers".
6. ________ the branch that designs cars and trucks.
7. ________ they are known as the "master builders".
8. ________ use chemicals to make physical changes in material.
9. ________ they design and make machines used by industry.
10. ________ the fastest growing branch of engineering, concerned with power for light, heat, and communications.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

USING DESIGN PRACTICES AS A DESIGN ENGINEER

Objective:

Given a design problem, you will design an object which will be a solution to your problem. The object you design must follow the basic rules of good design.

Activities:

Please read the following paragraphs to find out --

1. What are design engineers, and what do they do?
2. What are the rules of good design?
3. How do you attack a design problem?

The design engineer is the man that thinks up new ways of doing things, or thinks up new machines, or ways of making old machines better. He takes his idea and makes a sketch on paper, and works out all the details before the object is built.

Industrial design is a development of this century. Formerly, the man who made an object decided how it was to be shaped, or how it was to work. The wagonmaker or carriage builder designed his product as he built it. Today, industry has men called design engineers who earn good wages deciding how things are to be shaped, and how they will work. They put their ideas on paper in the form of a drawing. Other men then make these objects. A design engineer may design something small and simple like a hair pin, or something large and complicated like an airplane.

The first basic rule of good design is that the design must be functional. It must do the job, it must work. The design must be strong enough to do the job, without being heavy and bulky.

For example, we could make a baseball bat of solid steel. It would certainly be strong enough to do the job, but it would be to heavy too swing. Therefore, it would not be functional.

The second basic rule is that the design must be aesthetic -- this means pleasing to the eye or attractive. This is difficult to do, because we all have different ideas of what is beautiful. The designer trys to create a design that will be liked by himself and most people, without harming the function of the design.

For example, in the area of containers and packages the designer has a special problem. It has been found, that as a shopper walks down the supermarket aisle, each product stays in his line of vision for only four and a half seconds. The package will have to sell itself to him in that amount of time. In a case like this, the designer must consider the color combinations most pleasing to the customer.

As a general rule a good design should have flowing lines. We wish to do away with sharp corners because of safety and beauty. We can see the idea of flowing lines when we compare a new car with the old cars of the 1930's.

The last question is how to attack a design problem. The first step is to identify the problem, that is, what do you want the object to do. (This will be given to you in the design problem for this package.) You will want to think of all the possible ways to solve your problem. Every problem has at least two solutions. You might want to sketch your ideas and select the one that is best. After you have decided how to make your object you must decide on the type of material to be used, and the size of each piece (keep in mind function, strength, and aesthetics.)

Now, take a look at this design problem and make a sketch of your solution.

Problem:

You have eight large books on your desk. You find that these books take up most of the space on your desktop, and you have no room for writing. You want to design a device to hold the books in an up-right position so you can have more room on your desk for writing. Keep in mind the rules for good design, and be a design engineer by making a sketch of a device to solve your problem.

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Post Test:

Show your sketch to your teacher for his evaluation.

⑦

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MAKING A ROUGH SKETCH OF AN IDEA

Objective:

Given an idea of a particular object, you will make a rough sketch (drawing) of the object. The rough sketch must have enough views to completely describe the object.

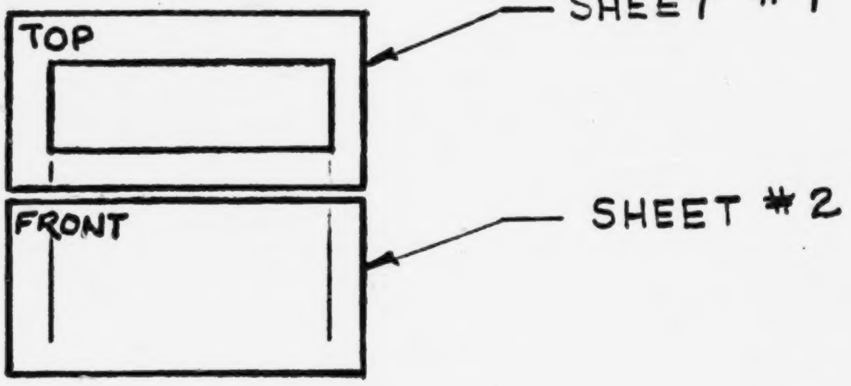
Prerequisite Skills:

If you have not had a class in Mechanical Drawing, please review Package E-3 (Blueprint Reading).

Activities:

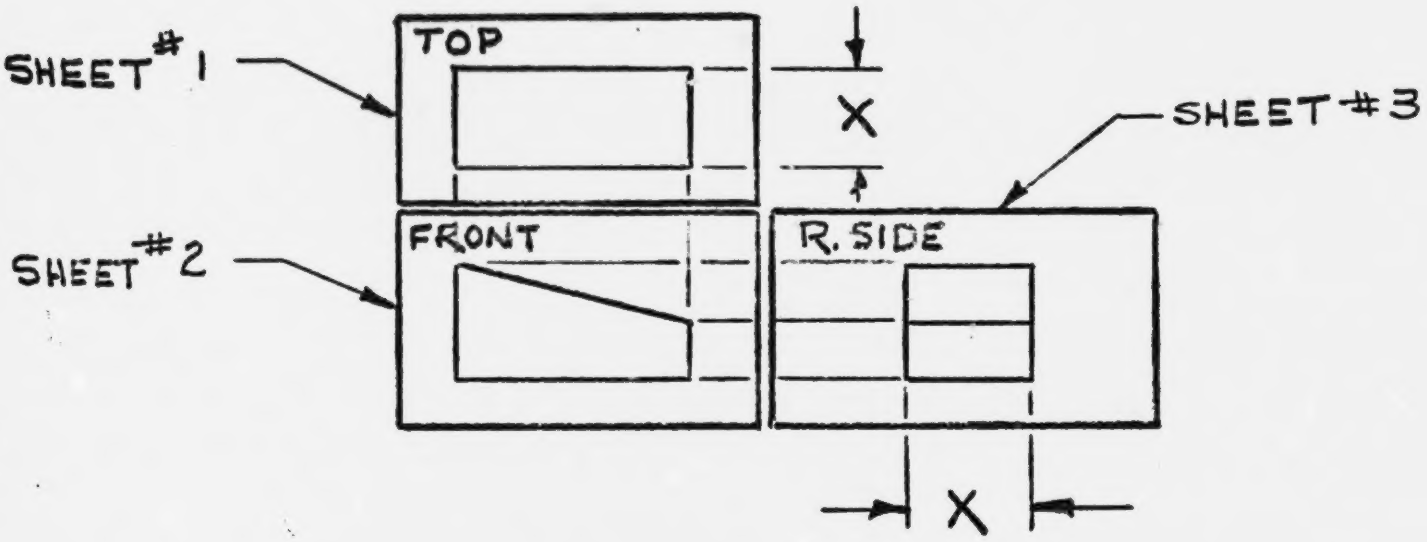
Go to your teacher and get 3 sheets of graph paper and a ruler. Your class has already completed product research and you have an idea of what product you want to manufacture. Your task is to take this idea and put it on paper in the form of a sketch.

1. Think about the object you are about to draw. Try to visualize (see with the mind's eye) how the object will look from the top.
2. Draw on one sheet of graph paper what the object would look like when you look at it from above. This will be the top view.
3. After the top view has been completed, use another sheet of graph paper to draw the front view. The front view must agree in length with the top view you have just completed. To make sure the front view will be the same length, place the sheet of graph paper for the front view to the bottom of the top view sheet, and draw lines from the ends of the top view down to the front view sheet. (See picture.)



4. Now that you have the length established for the front view, go ahead and draw what the object would look like as you look directly at the front of it. Two views may be enough to completely describe the object. If not, you must draw a third view. Objects like cylinders usually need only two views.

5. To draw a third view (right side view), place the third sheet of graph paper to the right of the front view sheet. The height of the object in the front view must be the same for the right side view. Draw lines from the front view over to the paper for the right side view to establish the height for the view. (See picture.)



6. After you have drawn lines to give the height of the right side view, you must get the depth (distance from front to back). The depth for the right side view must be the same as in the top view. See dimension "X" in the picture above.

7. Check the 3 views of the sketch to make sure they represent your idea as viewed from the top, the front, and the side.

Post Test:

Show the rough sketch to your instructor for his evaluation.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MAKING A ROUGH SKETCH OF AN IDEA

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Prerequisite Skills:

If you have not had a class in Mechanical Drawing, please review Package E-3 (Blueprint Reading).

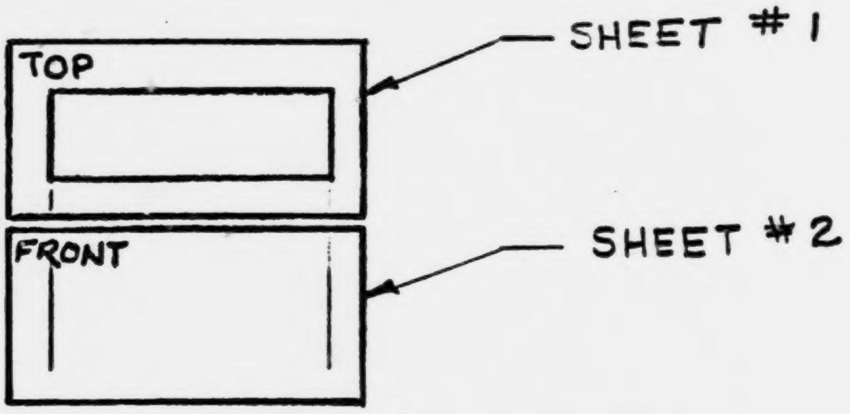
Activities:

Go to your teacher and get 3 sheets of graph paper and a ruler. Your class has already completed product research and you have an idea of what product you want to manufacture. Your task is to take this idea and put it on paper in the form of a sketch.

1. Think about the object you are about to draw. Try to visualize (see with the mind's eye) how the object will look from the top.

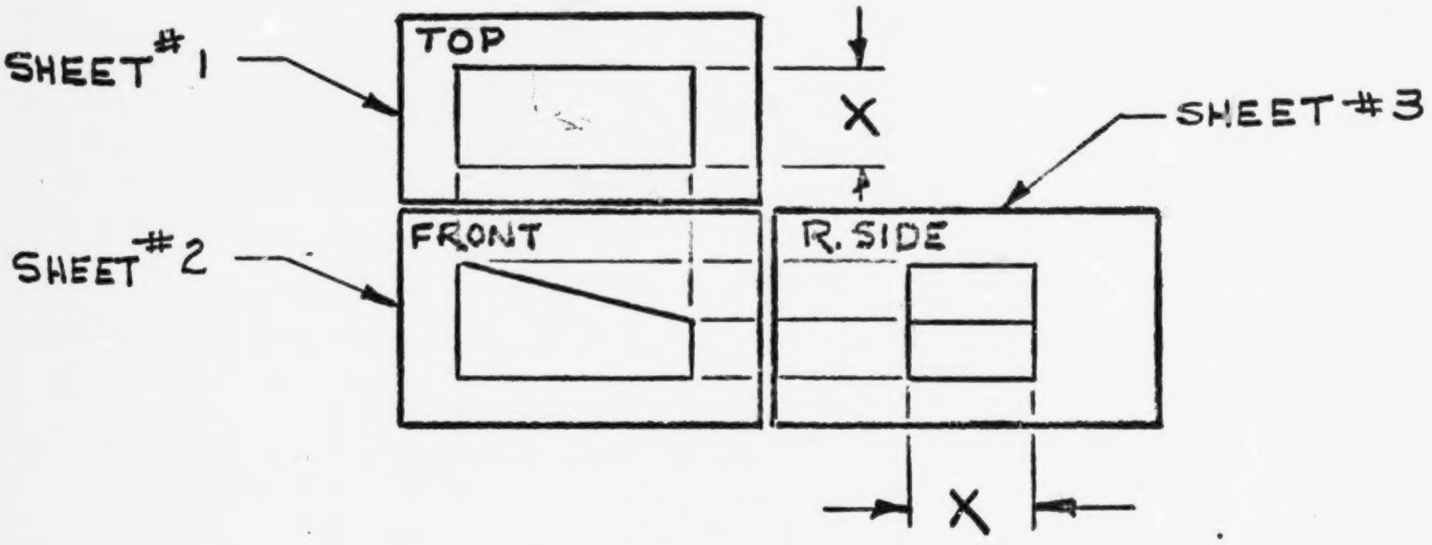
2. Draw on one sheet of graph paper what the object would look like when you look at it from above. This will be the top view.

3. After the top view has been completed, use another sheet of graph paper to draw the front view. The front view must agree in length with the top view you have just completed. To make sure the front view will be the same length, place the sheet of graph paper for the front view to the bottom of the top view sheet, and draw lines from the ends of the top view down to the front view sheet. (See picture.)



4. Now that you have the length established for the front view, go ahead and draw what the object would look like as you look directly at the front of it. Two views may be enough to completely describe the object. If not, you must draw a third view. Objects like cylinders usually need only two views.

5. To draw a third view (right side view), place the third sheet of graph paper to the right of the front view sheet. The height of the object in the front view must be the same for the right side view. Draw lines from the front view over to the paper for the right side view to establish the height for the view. (See picture.)



6. After you have drawn lines to give the height of the right side view, you must get the depth (distance from front to back). The depth for the right side view must be the same as in the top view. See dimension "X" in the picture above.

7. Check the 3 views of the sketch to make sure they represent your idea as viewed from the top, the front, and the side.

Post Test:

Show the rough sketch to your instructor for his evaluation.

FOR THE STUDENT

No. E-5

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

BUILDING A MODEL OF A PRODUCT

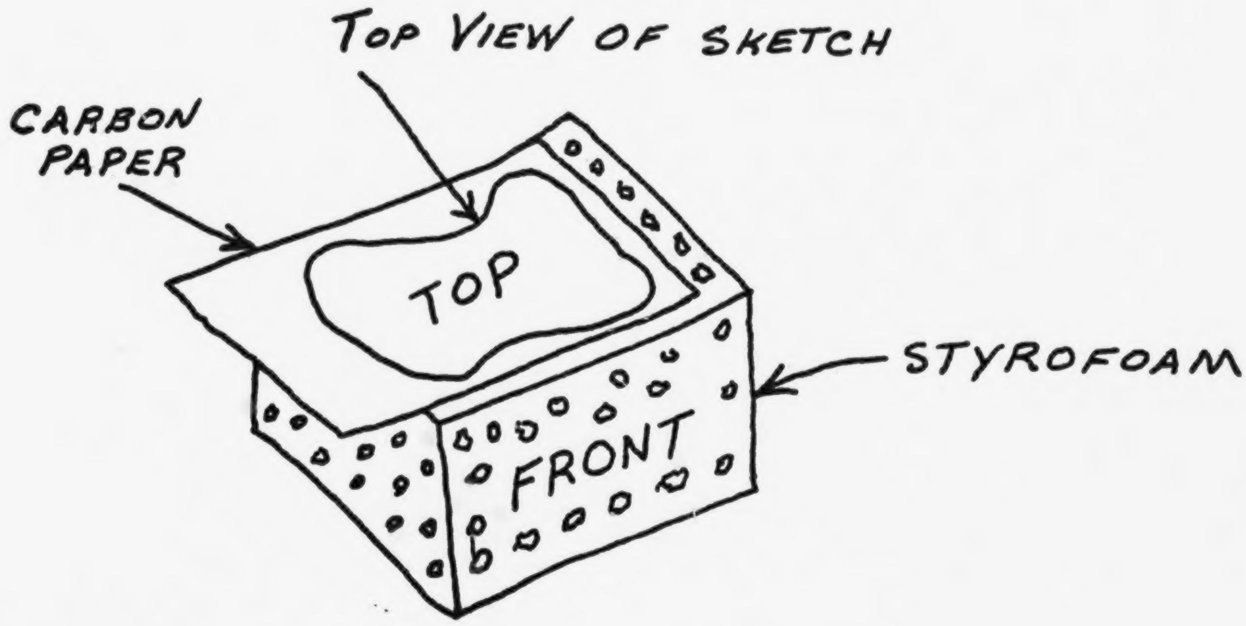
Objective:

Given a rough sketch of a product, plus the necessary tools and supplies, you will make a model of the product. The model must agree with the sketch in size and general shape.

Activity:

Go to your teacher and get a rough sketch of the product. Go to the supply room and get the following tools and supplies -- a piece of styrofoam, an X-acto knife, a coping saw, a sheet of carbon paper.

1. First, place the carbon paper on the styrofoam; then place the sketch over the carbon paper in a position so the top view of the sketch can be traced onto the top of the styrofoam block. (See drawing below). Take a pencil or ball-point pen and trace around the outline of the top view of the sketch. You should apply pressure to the pencil to make sure the carbon paper transfers the view to the styrofoam. Caution: Do not let the sketch move once you have started to trace around the view.



2. Remove the sketch and carbon paper from the styrofoam block. Now cut the styrofoam to the outline of the view using the coping saw. The X-acto knife may be used to trim in corners. The model is now to the correct size and shape, as viewed from a horizontal plane (top view).

3. Now turn the styrofoam so the front face will be up. Now repeat the tracing process of Step #1, using the front view of the sketch. Again, caution should be taken to hold the sketch in the same position once you have started tracing the view.

4. Remove the sketch and cut to the outline as you did in Step #2. The model is now correct in size and shape as viewed from a frontal plane (front view).

5. Now rotate the model so the right side is up. Using the right side view of the sketch and the carbon paper, repeat Step #1 by transferring the outline of the right side view of the sketch to the styrofoam.

6. Now cut to the outline as you did in Steps #2 and #4. The model is now correct in size and shape as viewed from the profile plane (side view).

7. Now examine your model to see that it agrees with your sketch for all three views, i.e., top, front, and right side. Show the model and the sketch to your teacher for his evaluation.

8. The purpose of the model is to allow you (the designer) to view your idea in three dimensions. You should now try to improve the design by removing or adding material (styrofoam). This is called making design improvements.

Post test:

After you have made your design improvements, show the model to your teacher again for his evaluation.

TEACHERS' REFERENCE INFORMATION FOR STUDENT PACKAGE NO. E-5

1. No time limitation is stated in the objective because the specific product may vary in complexity, which, in turn, will determine the time required to make the model.

2. For this package, the student may make a model using the sketch he made with package No. E-4. If the student did not complete package No. E-4, you will need to supply a rough sketch for this package.

3. The student will be using the following tools and supplies:

   a. An X-acto knife
   b. A block of styrofoam
   c. A coping saw.

   It is suggested that you have the styrofoam cut into blocks prior to giving this package to the students. You may wish to substitute soap or clay for the styrofoam.

FOR THE STUDENT No. E-6

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

BUILDING A FULL-SIZE MOCK-UP

OBJECTIVE:

Given the uses for a mock-up, the building instructions, and the necessary tools and material, you will construct a full-size mock-up of your product.

PREREQUISITE SKILLS:

You must complete package (E-4) and (E-5) before you start on this package.

ACTIVITY:

The full-size mock-up is usually made of wood or some other easily shaped material. The mock-up is designed to be used in working out space problems, and is not intended to function. You may or may not need to build a mock-up of your product. This depends on the nature and complexity of your product. (ask your teacher before you proceed.)

You have already made a sketch, and a model of your product. The mock-up will be the first full-size reproduction of your design. After completing the mock-up you may wish to make certain design changes. One use of the mock-up is to view your design in full size.

The full-size mock-ups made in industry are so realistic in apperance that they can be photographed and used by the advertising department prior to the making of the first product. Mock-ups are also used to determine the length of electrical wire bundles and the shape of pipes and tubing. On a drawing it is very difficult to determine the exact shape of a piece of pipe when it must be bent many ways to clear other components of the design.

The engineer can go to the mock-up, and bend the pipe to clear the components. He then uses the bent pipe as a pattern for production parts. A very good example of this is the tail pipe on your car.

Select a soft wood (Balsa or Basswood) for your mock-up because you are not concerned with strength, and soft wood is easy to shape. Start with the dimensions on your rough sketch. Caution -- do not measure the sketch to get the dimensions for your mock-up, because the sketch may not be drawn to full-scale. Make your mock-up agree in general shape with your model and sketch.

POST TEST:

Show your full-size mock-up to your instructor for his evaluation and answer the following questions.

1. Name four reasons for building a full-size mock-up.
2. Why do we use Basswood instead of Oak for mock-up building?

FOR THE STUDENT No. E-7

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

BUILDING THE PROTOTYPE

OBJECTIVE:

Given the rough sketch (from package E-4) and a model of a product (from package E-5) plus the necessary tools and materials you will build a prototype of a product.

PREREQUISITE SKILLS:

You must complete packages E-4, E-5, and E-6 before you start on this package.

ACTIVITY:

The prototype will be the first workable product from your design. It will be different from other products in that it will be custom made. The assembly line will be used to produce the product after all the details have been worked out using the prototype.

Study the sketch and the model you have made with previous packages. You will now make a full size, workable product. As you construct the prototype make sure it agrees with your sketch and model in size and general shape. It is very important that you keep a set of notes as you proceed with the building of the prototype. You should note all problem areas. These would include operations requiring jigs and fixtures, special tools, and special machines. This information is to be given to the tool designers, and the plant engineer for their use in designing the assembly line.

The prototype must be functional. It must work or operate as it was intended. All problem areas must be reported to the design engineers who are making the final drawings of the product. These final drawings will be used to mass produce the product. All design changes and improvements should be made on the prototype before the product goes into production on the assembly line.

POST TEST:

Show your prototype to your instructor for his comments and evaluation. Discuss all problem areas with the product designers. Furnish the tool designers with a list of operations which require jigs and fixtures, special tools, and special machines.

FOR THE STUDENT No. E-8

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

THE PRODUCT ENGINEER

OBJECTIVE:

Given the duties and responsibilities of the product engineer and his staff, you will take a typical engineering problem and delegate the work to members of your staff.

ACTIVITIES:

(Duties and Responsibilities of the Product Engineer)

We are familiar with design problems that are small and simple. Suppose you have been asked to design an airplane, a large bridge, or a large office building. How would you approach this complicated task? Large and complicated products may require hundreds of drawings to completely explain or describe all of the parts of the product.

It is the job of the product engineer to break this task into smaller sections, and designate certain people on his staff to work on a particular section, or piece, of the overall product. The chief product engineer will make the original calculations and sketches for a new product. After making the original calculations, the cheif product engineer will sub-divide the task into systems, and assign a product engineer to each major system. An airplane has several systems, and each system can be designed by a special group. These systems would include structures, electrical, heat and ventilation, controls, and power plant.

The product engineer for each system makes a design layout of his system. The design layout will be discussed further in package E-9. After the design layout is completed, the product engineer for each system further sub-divides the task into sections. These sections, or pieces, of the system are given to staff members for further design and detailing.

The members of the product engineers staff are called design draftsman and detailers. The design draftsman will be assigned to a part of the system by the product engineer for that system. He will design the larger parts of the system, and further sub-divide the task into smaller parts.

The small parts, called details, will be drawn up by the detailer. The detailer makes separate drawings for each small piece or part of the design. As the detailer makes each drawing he must check to see that each part will fit into the overall system as it was planned by the product engineer for that system.

PROBLEM:

You are the chief product engineer for an appliance company. You have been selected to design a modern kitchen refrigerator. Your staff includes three product engineers. One of these product engineers is a specialist on electrical curcuits, one is a specialist on sheet metal design, and the third is a specialist on refrigeration gases and curcuits. Each of the three product engineers have one design draftsman and two detailers to work for him. Your staff has the following letter designations --

Chief Product Engineer (you)--------------A

Product Engineer (electrical)--------------B

Product Engineer (sheet metal)-------------C

Product Engineer (refrigeration)-----------D

Design Draftsman (electrical)--------------E

Design Draftsman (sheet metal)-------------F

Design Draftsman (refrigeration)-----------G

Detailer (electrical)----------------------H

Detailer (sheet metal)---------------------J

Detailer (refrigeration)-------------------K

POST TEST:

Using the letter designations for the men on your staff assign your men to the following tasks by placing a letter in the blank space. You may only use each man one time.

1.______will make the layout for the electrical system.

2.______will design the door assembly for the refrigerator.

3.______will make the drawing for the door hinges.

4.______will make the drawing for the pully of the compressor.

5.______will design the compressor.

6.______will do the orginal calculations and sketches for the entire refrigerator.

7.______will make the layout for the sheet metal body.

8.______will make the drawing for the light socket (interior)

9.______will design the main electrical panel.

10.______will make the layout for the refrigeration system.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. E-8

This package is designed to establish the concept of how a team of many engineers and draftsmen work together to produce a complex product. You may wish to elaborate on each of the job classifications mentioned in this package. You may wish to assign research reports on the various jobs in engineering, or have a guest speaker from engineering in conjunction with this package.

Answers to Post Test:

1. B
2. F
3. J
4. K
5. G
6. A
7. C
8. H
9. E
10. D

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MAKING A LAYOUT

OBJECTIVE:

Given a rough sketch of an idea (package E-4) with the design changes made while making the model (package E-5) and the necessary drafting tools, you will make a layout of your product.

PREREQUISITE SKILLS:

You must complete packages E-4 and E-5 before you start this package. If you have not had a class in Mechanical Drawing it is recommended that you review package E-12 (making a drawing) prior to doing this package.

ACTIVITY:

The purpose of the layout is to assure that all parts of the product will fit together and function properly. If the final product is made up of several parts, a layout is necessary. Detailers will use the layout to obtain information when they make the detail drawings.

The layout must be made very accurately. Use a hard (2-H) pencil when drawing the layout. Make sure your pencil is sharp at all times. The layout will have just enough dimensions to describe the overall size of the product, and to locate critical parts. The detailer must measure the layout to obtain some dimensions of the parts. For this reason it is very important that the layout be accurate, and drawn to a definite scale. Scale is the size relationship of the drawing to the finished product. Half-scale means the drawing is exactly one-half the size of the product.

PROCEDURE:

1. Select a sheet of drawing paper for your layout. The size of the paper is determined by the size of your product and the scale you wish to use.

2. Select a hard lead drawing pencil and other drafting tools, i.e. triangles, scale, T-square.

3. Secure your drawing paper to a drawing board with four pieces of drafting tape.

4. Determine the exact scale for your layout. If your drawing paper is large enough for 3 views of the product drawn full-size, use full-scale. Other common scales are half-size, fourth-size, and one inch equals one foot for very large objects.

5. Layout the outline for the 3 views of your product. Remember the top and front views must line up vertically, and the front and side views must line up horizontally. Use your sketch and model as reference as you draw the views.

6. Fill in the views so they completely show all the detail of each view.

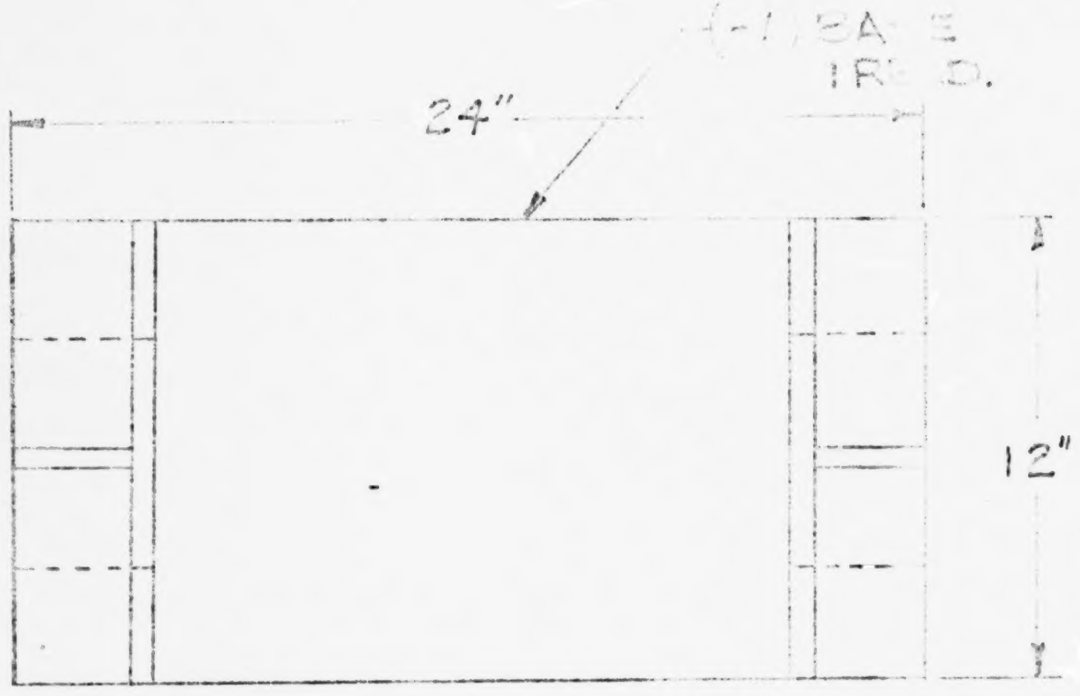
7. Dimension your layout by adding the overall dimensions, i.e. total length, total height, and total depth.

8. Add any other critical dimensions. These are dimensions that must be exact if the product is to function.

9. If your product has several separate parts, assign dash numbers to the parts for identification. Use consecutive odd numbers starting with -1. Draw a small circle around the dash numbers with a leader pointing to the part the dash number represents. (see sample layout)

10. Add notes to your layout to explain any information which is not given by the views. The detailer will use this information when he makes separate detail drawings of the parts. These notes might include types of material to be used, and means of fastening the parts together.

SAMPLE LAYOUT



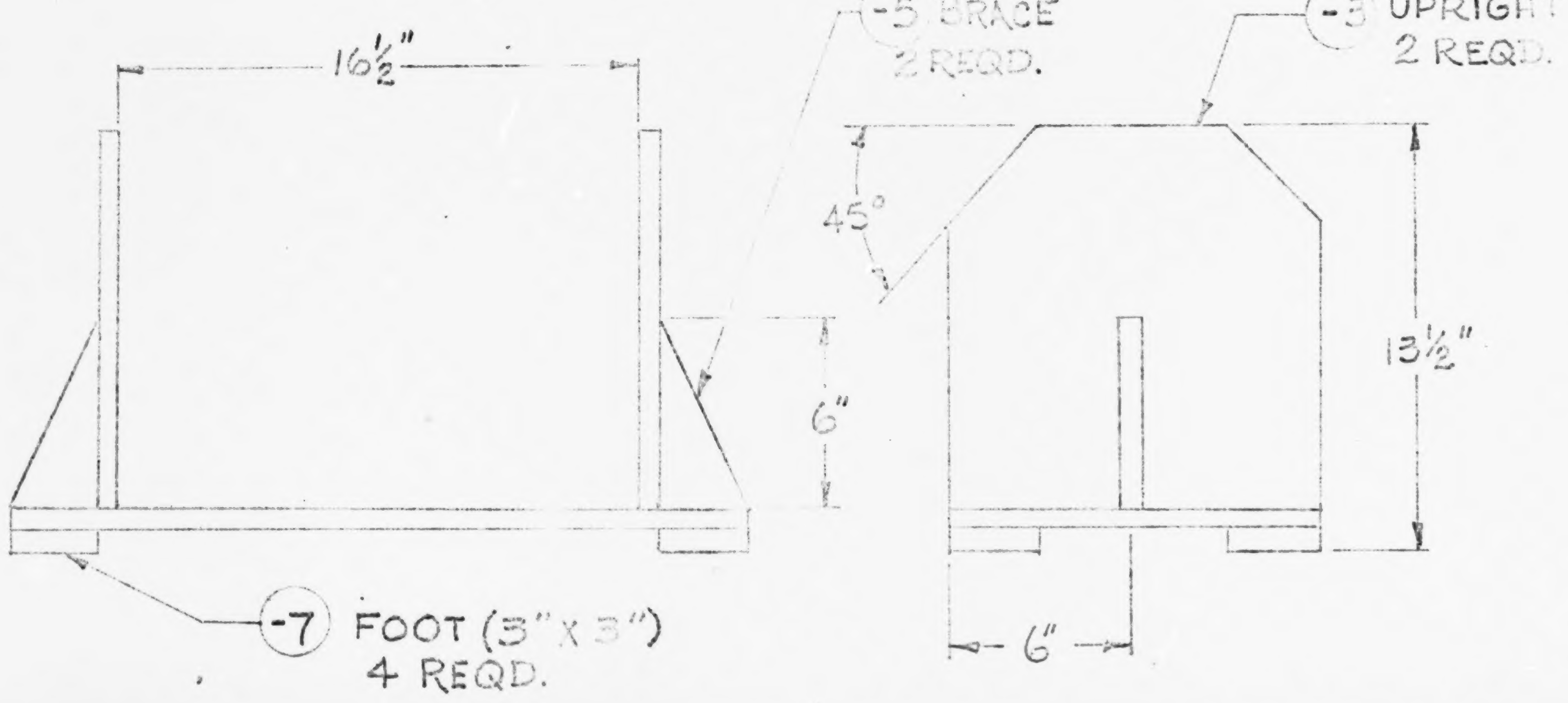
-1 BASE
1 REQD.
24"
12"

BOOK SHELF

SCALE 1" = 6"   4-5-70

DRAWN BY - B.G.T.

NOTE :
ALL PARTS TO BE MADE
FROM 3/4" PINE WOOD



-5 BRACE
2 REQD.
-3 UPRIGHT
2 REQD.
16½"
45°
6"
13½"
-7 FOOT (3" X 3")
4 REQD.
6"

11. Check the layout to make sure you have given enough information on your layout to allow the detailer to detail the separate parts. The scale of the layout, the date, and your name should appear on the layout. (see sample layout)

12. After the layout has been completed it will be necessary to make a detail drawing of each dash number part. The final drawing will be called an assembly drawing which shows how the parts are fastened together.

POST TEST:

Show your layout to your instructor for his evaluation.

FOR THE STUDENT No. E-10

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MAKING REQUESTS TO RESEARCH AND DEVELOPMENT

OBJECTIVE:

Given a problem concerning a failure of a material, or a process during assembly, you will fill out a special form to research and development. This will cause R and D to do further research to correct the problem.

ACTIVITIES:

When the assembly line starts to move and products are starting to be produced, we usually find some unexpected problem. The problem may be caused by a material failure, or a process failure. After the problem has been identified we must make a request to research and development for further research to correct the problem.

A typical form for requesting additional research would look like this example form.

check one

MATERIALS REJECTION REPORT____________________ ☐

PROCESS REJECTION REPORT______________________ ☐

REASON FOR REJECTION (problem)

SOLUTION

Using the sample form and the problem given here, you will construct a form and fill in the information.

PROBLEM

The assembly line workers report that the hole patterns on two parts do not line up to allow the parts to be bolted together.

POST TEST:

Take your completed form to your instructor for his evaluation. Now take the form to the research and development group. They will use your information to do package D-33.

FOR THE STUDENT No. E-11

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

DRAFTING TOOLS

OBJECTIVE:

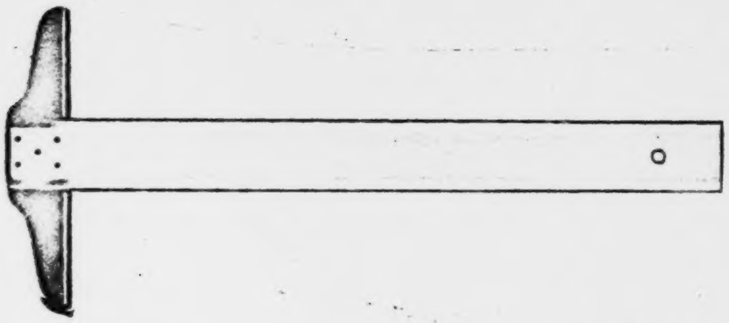
Given a list of drafting tools, and a list of descriptions of the different drafting tools, you will match the correct tool with the correct description.

ACTIVITY:

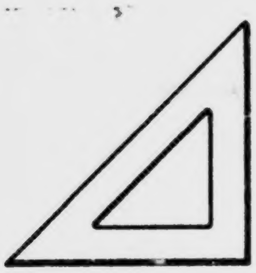
(learn the names and descriptions of the following drafting tools.)

1. Drawing Board--is used to hold the paper. The paper is secured to the board with drafting tape.

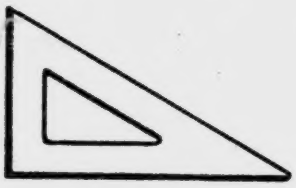
2. T-square--has a head that is guided along the edge of the drawing board, and a blade used as a guide for ruling parallel lines across the paper.



3. 45 degree and 30-60 degree triangles--used in combination with the T-square and with each other as guides to produce vertical lines and lines inclined at angles from the horizontal.

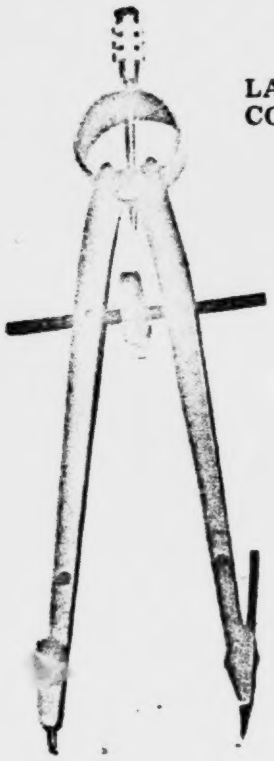


45 degree

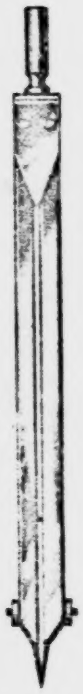


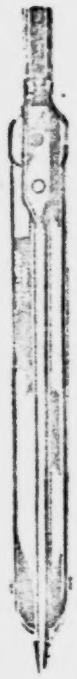
30-60 degree

4. Bow Compass--for drawing arcs and circles.



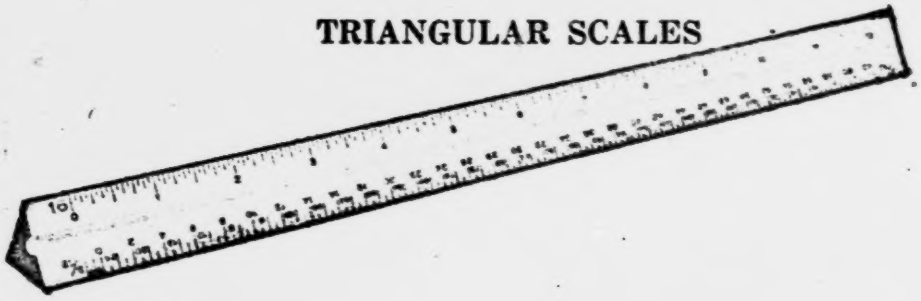
5. Dividers--for picking up and transferring distances, and for dividing lines into equal segments.





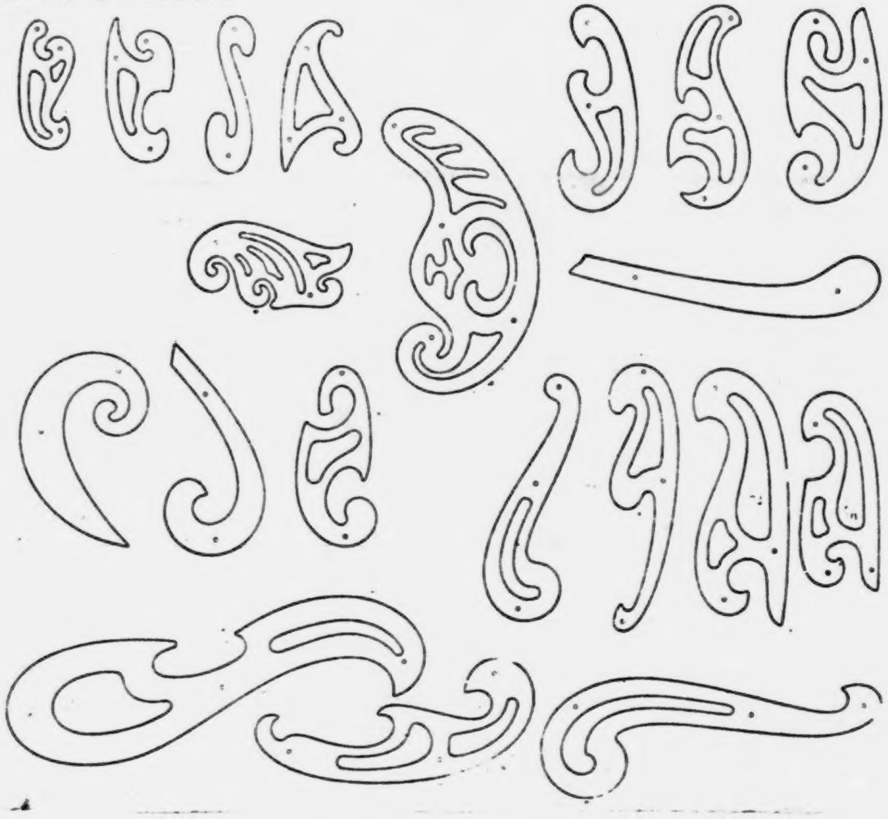
6. Triangular Scales--divided in proportion to the divisions of the usual 12-inch scale, so that it is convenient to make drawings by direct measurement to reduced scales such as 3 inches equals 1 foot, 1 inch equals 1 foot or ¼ inch equals 1 foot.

TRIANGULAR SCALES



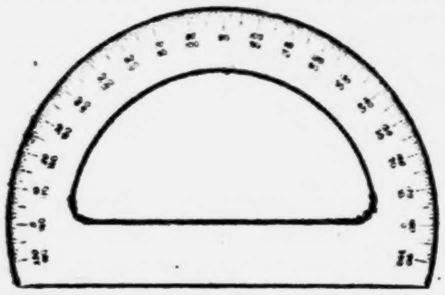
7. Irregular Curves--often called French curves, used for ruling smooth curves through a series of points.

IRREGULAR CURVES



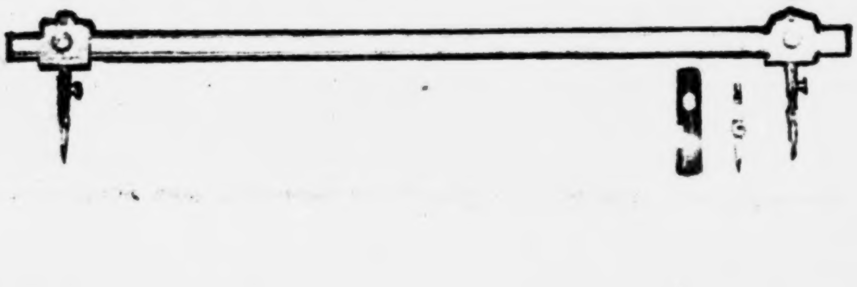
8. Protractor--used to measure and layout angles.

TRANSPARENT PROTRACTORS



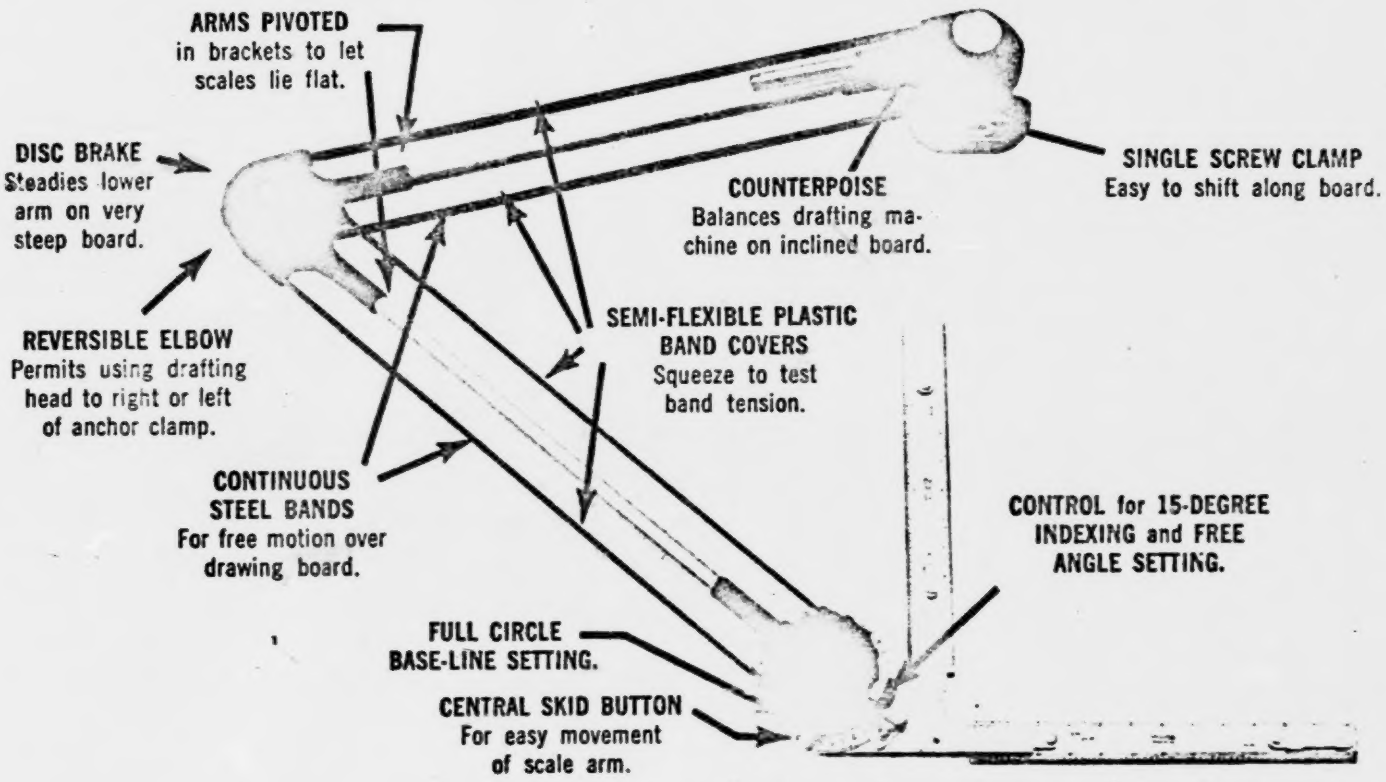
9. Beam Compass--for drawing large circles and arcs.

BEAM COMPASS SETS



10. Universal Drafting Machine--a device combining the functions of the T-square, triangles, and scales in a mechanism which uses special scales as a straight edge for ruling and mounts them on a head movable anywhere over the board, while maintaining the scales in a perpendicular and parallel condition. The head also turns to obtain angles.

VEMCO STANDARD DRAFTING MACHINE


ARMS PIVOTED in brackets to let scales lie flat.
DISC BRAKE Steadies lower arm on very steep board.
SINGLE SCREW CLAMP Easy to shift along board.
COUNTERPOISE Balances drafting machine on inclined board.
REVERSIBLE ELBOW Permits using drafting head to right or left of anchor clamp.
SEMI-FLEXIBLE PLASTIC BAND COVERS Squeeze to test band tension.
CONTINUOUS STEEL BANDS For free motion over drawing board.
CONTROL for 15-DEGREE INDEXING and FREE ANGLE SETTING.
FULL CIRCLE BASE-LINE SETTING.
CENTRAL SKID BUTTON For easy movement of scale arm.

POST TEST:

Name________________________

Drawing Board-------A
T-square------------B
Triangles-----------C
Compass-------------D
Dividers------------E
Protractor-----------F
Triangular Scales----G
Irregular Curves-----H
Beam Compass---------I
Drafting Machine-----J

Place the correct letter designation for the drafting tools above in the blank space of the description for each drafting tool.

1.________used for picking up and transfering distances, and for dividing lines into equal segments.

2.________often called French curves, used for ruling smooth curves through a series of points.

3.________used to hold the paper.

4.________used in combination with the T-square and with each other as a guide to produce vertical lines and lines inclined at angles from the horizontal.

5.________makes it convenient to make drawings by direct measurement to reduced scales such as 3 inches equals 1 foot, 1 inch equals 1 foot etc.

6.________for drawing arcs and circles.

7.________has a head that is guided along the edge of the drawing board.

8.________a device combining the functions of the T-square, triangles, and scales.

9.________for drawing large arcs and circles.

10.________used to measure and layout angles.

FOR THE STUDENT   No. E-12

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

THE DRAFTSMAN AND HIS DUTIES

OBJECTIVE:

Given a written description of an object, you will make a mechanical drawing which will be a graphical representation of the written description.

PREREQUISITE SKILLS:

Review the following packages before you start this package.

(E-4) Making a Rough Sketch of an Idea

(E-11) Drafting Tools

(H-43) Reading Two and Three View Drawings

ACTIVITIES:

Please read the following paragraphs to find out--

1. The duties of a draftsman.
2. Where the draftsman gets his information to make a drawing.
3. What determines a good draftsman.

A draftsman is one who makes mechanical drawings. The mechanical drawing is the graphical representation of objects made with the aid of mechanical devices called drafting tools, as contrasted with freehand methods. The draftsman may also be called upon to make graphs and charts. These charts show the progress being made, by the company or department, on a particular project. The draftsman must do his work with complete accuracy because his drawing serves as the language of communication for architects, engineers, and workers.

The greatest use of the mechanical drawing is to give instructions to others, generally so one person can make what another person has designed.

Where does the draftsman get information and instructions for making a drawing? Usually the information to the draftsman comes from an engineer, a designer, a design draftsman, or a drafting group leader. Reguardless of the title, this person would be in charge of a particular part of the drafting operation. The information may come to the draftsman in three forms which are--(1) verbal or written description (2) a sketch or (3) from a layout. Using the first form an engineer would simply tell or send a note to his draftsman which would describe in words the object to be drawn. The draftsman would convert these words into a drawing.

There are several traits which determine a good draftsman. A good draftsman will produce a drawing that is complete to the smallest detail, accurate, and neat. At the same time a good draftsman must complete his drawings in the shortest possible time.

In this package you are required to be a draftsman and convert a written description of an object into a three view drawing. Read the following description carefully.

TO THE DRAFTSMAN:

Make a three-view drawing of a wooden box. This box will be used to store sheets of typing paper. The inside dimensions of the box must be one-half inch larger than a sheet of paper. The inside dimensions of the box will be 11½ inches x 9 inches and 3 inches deep. Make the four sides of the box from ½ inch thick pine wood. Make the bottom of the box from ½ inch thick plywood. Leave the top of the box open. The box is held together with finishing nails.

1. After you have a picture of the object in your mind think about how to draw the object as a three view drawing.

2. Ask your teacher for the necessary drafting tools and supplies needed for this job.

3. Decide on the scale of the drawing. How large will your drawing be in proportion to the actual box? The scale will depend on the size of your drawing paper. If your paper is large enough to draw the box the same size as it will actually be, use full scale. If your drawing will be half the size of the actual box, use half-size.

4. Draw your three view drawing of the box. Make sure your drawing is complete, accurate, and neat.

5. Add dimensions to your drawing so a worker will have enough information to build the box.

6. Check your drawing and read the written description again to make sure your drawing and the written description are one and the same.

POST TEST:

Show your completed drawing to your teacher for his evaluation.

FOR THE STUDENT No. E-13

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MAKING A PRODUCTION DRAWING

OBJECTIVE:

Given a layout (package E-9) showing the pieces that make up the product, you will make a production drawing for each individual piece of the product. The production drawings must give enough information to allow other workers to make the product on an assembly line.

PREREQUISITE SKILLS:

Prior to this package you should have completed packages E-4, E-5, E-6, E-7, E-9, E-11, E-12, and H-43.

ACTIVITIES:

At this point you should have made a rough sketch of an idea, built a model, built a full-size mock-up, built a prototype, and made a layout of the product. The next step in planning for production is to make a production drawing, or a working drawing, of each individual piece of the product. The production drawing, or working drawing, you are about to make is the drawing from which the work, or production, will be done. These drawings will be reproduced (copies will be made) so each worker on the assembly line can have a copy. For this reason the drawings must be neat, accurate, and correct. If the drawings are wrong the product will be wrong when it rolls off the assembly line.

(follow these steps in making your drawing)

1. Go to your teacher and get drawing paper and drafting tools.
2. Start by determining the scale for your drawing. Try to allow about 2 inches between views.

3. Layout the basic views for the drawing. Make sure you use orthographic projection, that is, the top and front views must line up vertically and the front and right side views must line up horizontally (see package E-4). The views should be drawn lightly using a hard (4H) pencil at first. After you are sure the views are correct you can go back with a soft pencil (H) and heavy in the views. The outside edge of each view, called object lines, should be heavy.

4. After the views are complete you must add dimensions. The drawing should show enough dimensions to allow the part to be made. A good test for dimensioning is to ask this question. Could I make this part with the information given on this drawing? At this time you should add notes for drilling holes and any special operations.

5. Leave a space in the lower right hand corner of your drawing for a title block and a list of material. These items will be added to your drawing when you do package E-14.

6. You must make a separate drawing for each piece of the product.

POST TEST:

Take your drawing, or drawings, to your instructor for his evaluation.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

ESSENTIAL DRAWING INFORMATION

OBJECTIVE:

Given a production drawing made with packages E-13, you will complete this drawing by adding the title block information and a list of material.

PREREQUISITE SKILLS:

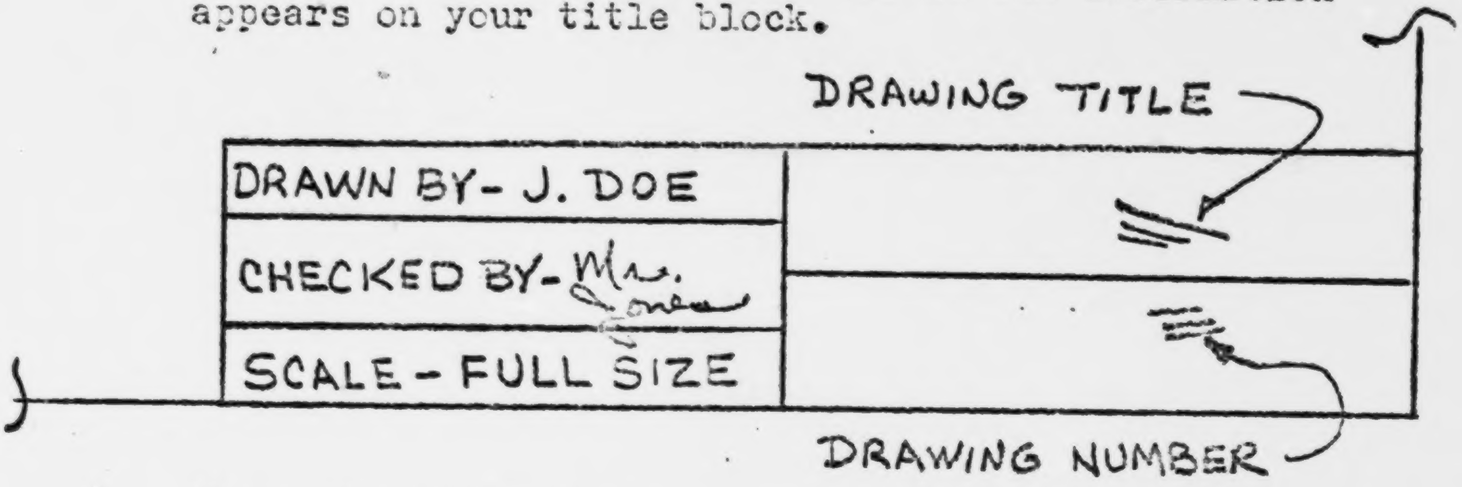
Do package E-13 before you start on this package.

ACTIVITIES: (continue with your package from E-13)

1. You may wish to draw a border line around your drawing. This is not required but will improve the appearance of the drawing. The border line is a heavy line drawn ½ inch from the edge of the paper on all four sides.

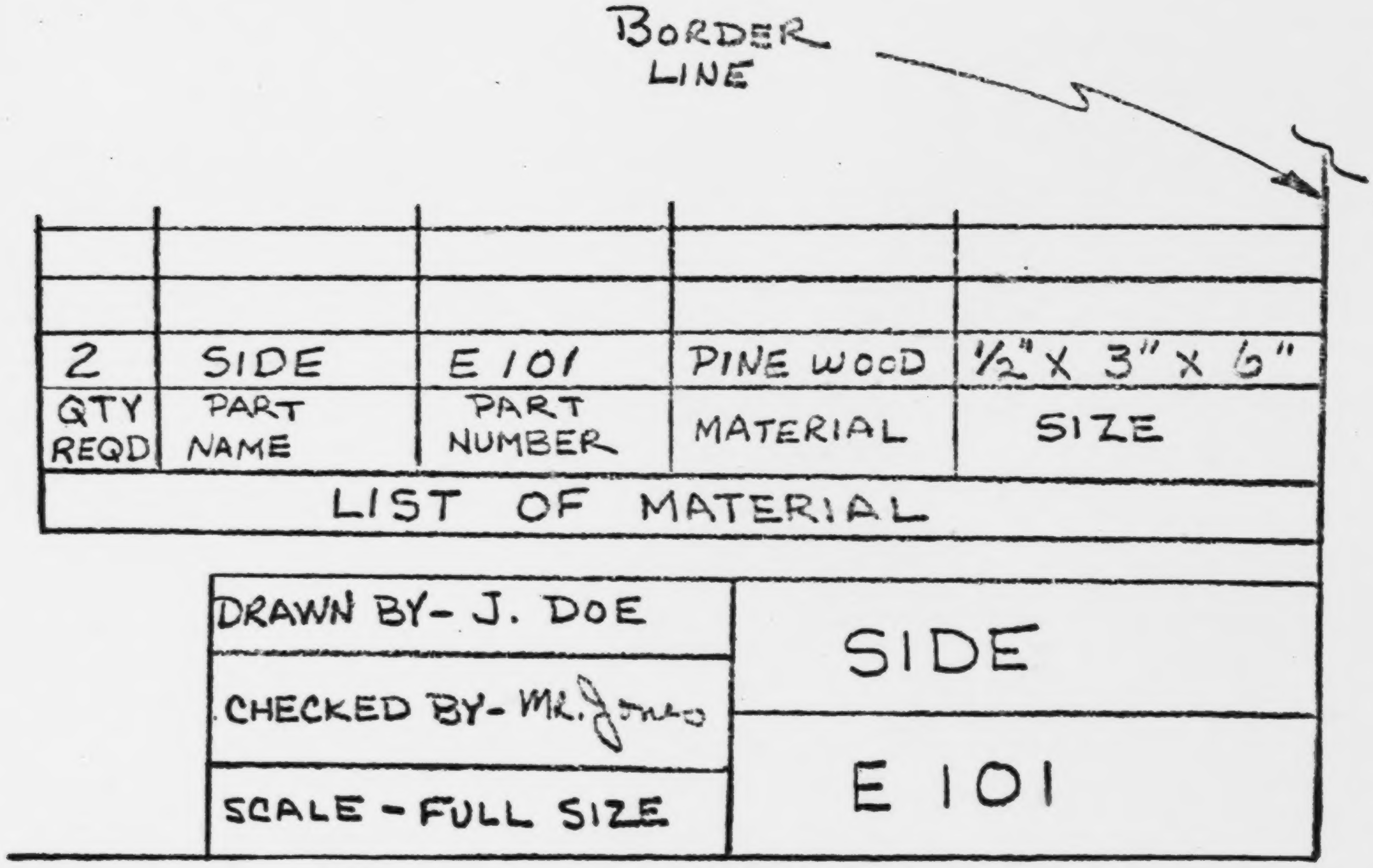
2. In the lower right hand corner of the drawing draw a title block. The title block will have 5 spaces. One space will be for the title of the drawing. The draftsman gives the drawing a name which describes the part on the drawing, example "Main Body". This name goes in the space in the title block provided for the drawing title. Another space in the title block is for the drawing number. The number will be assigned by your instructor. Numbers assigned will be discussed in package E-16. One space in the title block will be labeled drawn by-, your name will go in this block. Another block will be labeled checked by-, the person who checks your drawing will sign his name in this space. The last space in the title block will be labeled scale. You will print the scale of the drawing in this space.

3. Below is a suggested arrangement for a title block. You may wish to rearrange the spaces on your drawing. The important thing is that all of the information appears on your title block.



DRAWN BY- J. DOE	
CHECKED BY- Mr. Jones	
SCALE - FULL SIZE	

4. Above the title block on your drawing draw a list of material or parts list. A typical list of material looks like this.



2	SIDE	E 101	PINE WOOD	½" X 3" X 6"
QTY REQD	PART NAME	PART NUMBER	MATERIAL	SIZE
LIST OF MATERIAL				

DRAWN BY- J. DOE	SIDE
CHECKED BY- Mr. Jones	
SCALE - FULL SIZE	E 101

On a detail drawing you will only have one piece listed in the list of materials. On assembly drawings the list of material will contain all the parts or pieces required to make the product.

Going from left to right the first column of the list of material is labeled No. REQD. (see example on page 2). In this column you will place the number of this piece required on the final product. That is if you are making a drawing of a side of a box and 2 sides are exactly alike you would put a 2 in the QTY REQD. column. The next column is labeled Name. On a detail drawing this would be the same as the name in the title block, to follow our example we would write Side. The next column is labeled Part Number. On the detail drawing this number will be the same as the drawing number. The next column is labeled Material. In this column put the type of material used to make the piece, that is Pine Wood in the example. The next column is labeled Size. In this column put the rough size of the stock required for the part. The thickness should be listed first, followed by the width, followed by the length of the stock.

As stated above a detail drawing of one piece would have only one part listed in the list of material. An assembly drawing (showing all the pieces and how they fit together) would have all the parts required to make the product listed in the list of material. On the list of material for an assembly drawing list the QTY REQD. of each piece, the part name, and the part number. The material and size columns should be left blank on an assembly drawing because this information is available on the detail drawings.

5. Prepare a title block and a list of material for each of your production drawings.

POST TEST:

Show your drawing to your teacher for his evaluation.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

CHECKING THE DRAWING

OBJECTIVE:

Given a production drawing, one red crayon, and one yellow crayon, you will check every item on the drawing.

PREREQUISITE SKILLS:

You must complete packages E-13 and E-14 prior to doing this package.

ACTIVITIES:

1. Exchange your production drawings with another student working in the area of planning for production. You will check his drawings while he is checking yours.

   NOTE: If you have a blueprinting machine in your school, run a copy of your original tracing and give the copy to the checker. After the checker has checked your copy you can correct the original tracing. If you do not have a blueprinting machine and cannot run a copy, you will be required to redraw the drawing after it has been checked.

2. Every checker must have one red crayon and one yellow crayon. As you check each item on the drawing you will color lightly over the item with a crayon. Color the information on the drawing yellow if it is correct, and color the information red if it is not correct.

3. Start with the title block and list of materials of the drawing, and work your way over the entire drawing coloring each item as it is checked.

4. As you check each dimension on the drawing measure the view to see that it is drawn to scale. All dimensions should be checked carefully. Make sure all numbers on the drawing are readable, if they are not, color them red.

5. After you have finished checking the drawings you should exchange them for your own drawings. It is your responsibility to make corrections to your drawings. Change all items on your drawings that have been colored red. If the error or mistake is not obvious to you, you may need to ask the checker why he marked the item red.

6. After all red items have been changed on the original tracing, or a new drawing has been made to correct the items, take the drawing to the checker. He will inspect your drawings and you can inspect his to see that all red items have been changed.

7. When both you and your fellow student are satisfied that the drawings are correct you must sign each others drawings in the space in the title block marked, "checked by-". When you sign a drawing as a checker you are taking the responsibility for the drawing being complete and accurate.

POST TEST:

Take your checked drawings to your instructor for his approval. Take the student who signed your drawings as checker to explain to the instructor what changes were made during checking.

FOR THE STUDENT No. E-16

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

NUMBERS ASSIGNMENT AND HOW IT WORKS

OBJECTIVE:

Given your production drawings, you will have a drawing number assigned to each of these drawings. The drawing numbers must be assigned in such a way that you never have two drawings in your system with the same number.

PREREQUISITE SKILLS:

This package is the next logical step in planning for production after package E-15.

ACTIVITIES:

In a large manufacturing operation you will find many drawings with many drawing numbers. The drawing number also serves as a part number, or identification number for the piece made from the drawing. For this reason it is very important that each drawing have a different number. As an example of what might happen we look at the parts on a car. What would happen if the drawing for the front fender had the same number as the drawing for the hood? This would tell the men in the shop to stamp the same number into both parts. A customer needs a new fender for his car, and he orders the fender by a part number. If both the fender and the hood have the same number the customer may get a hood when he needs a fender.

Every large engineering office has a person or group of people responsible for assigning numbers to all drawings. After the draftsman has his drawing signed by checking (E-15), he takes his original tracing to numbers assignment, so they can assign the drawing a number. The people in numbers assignment keep a list, in a large book, of all drawing numbers along with the title of the drawings to which the numbers are assigned. When the draftsman takes his drawing to numbers assignment he is given the next available number for his drawing, and this number along with the title of the drawing is recorded in the numbers assignment book.

It is very important that one person or one group issue all drawing numbers. If every draftsman assigned any number to his drawing we would soon have several drawings with the same number.

In your school operation you will not have very many different drawings, and the assignment of drawing numbers will be an easy task as compared with the assigning of drawing numbers in a large industry. It is still very important that each drawing have a different and separate drawing number.

Your teacher will act as numbers assignment for your operation. Take your drawings, along with your answers to the post-test, to your teacher. He will assign your drawing a number and record that number and the drawing title so no other drawing will be given the same number.

POST TEST:

In your own words write a short paragraph telling why each drawing should have a different drawing number.

TEACHERS REFERENCE INFORMATION FOR STUDENT PACKAGE NO. E-16

In this package the students are made aware of the importance of having a seperate and different drawing number for each drawing.

You are asked to serve as the numbers assignment clerk. It is suggested that you have a special sheet to record the drawing numbers along with, the drawing titles, and the draftsman's name as the numbers are assigned. The particular numbers you assign are left to your own discretion. The important need for the record is to help you to insure that no two drawings have the same drawing number.

As each student comes to you for a drawing number check his answer to the post-test, to see if he understands why each drawing should have a different number prior to assigning a number to his drawing.

FOR THE STUDENT No. E-17

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

DRAWING REPRODUCTION

OBJECTIVE:

Given a production drawing, you will reproduce your drawing so other workers may have a copy.

PREREQUISITE SKILLS:

You must complete packages E-13, E-14, E-15 and E-16 before you start on this package.

ACTIVITIES:

In industry drawings are reproduced by using several reproduction processes. Some of these processes are: (1) The iron process; (2) The diazo process; (3) The silver process; (4) The electro static process; and (5) The heat process. We will not discuss each of these processes at this time. If you are interested in these processes ask your instructor for additional information on drawing reproduction.

You will reproduce (make copies) your drawing using the equipment available in your school. Most schools have a blueprinting machine. "Blueprint" is the name of the first reproduced drawing which was a drawing having a blue background with white lines. The name now refers to any reproduced drawing. Most modern blueprint machines produce a drawing with a white background and blue lines. If your school has a blueprint machine have the drafting instructor show you how to run your original drawing through the machine to make copies.

If you do not have a blueprint machine in your school you will use ditto masters to reproduce your drawings.

When using ditto masters to reproduce your drawings:

1. Ask your instructor for ditto masters.
2. Remove the tissue paper found between the sheets of the ditto masters.
3. Trace your production drawing on the ditto masters.
4. Take the ditto masters to the school secretary and ask her to run copies of your drawings.

POST TEST:

Show your copies to your instructor and give him a copy of each drawing.

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING

NOTES FOUND ON BLUEPRINTS

Objective:

Given the programmed learning packet notes on blueprints, you will identify the different notes found on a blueprint.

Activities:

1. Get the programmed learning packet "Notes on Blueprints" from the teacher.
2. Read directions on packet carefully.
3. Follow the steps in the package until you have completed all problems.
4. Get "Post Test" from teacher.
5. Complete "Post Test".
6. Return post test to teacher to be marked.

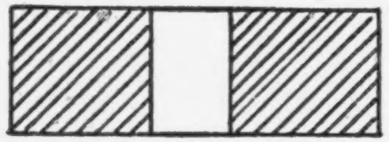
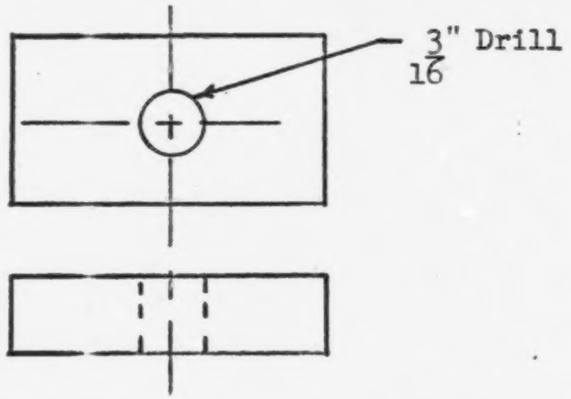
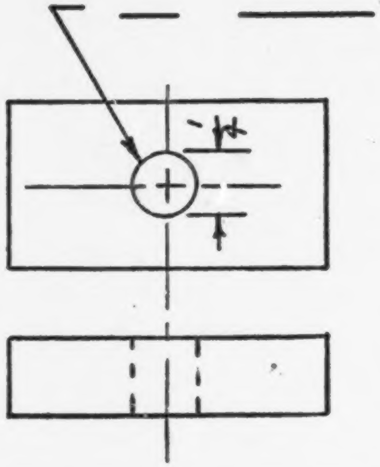
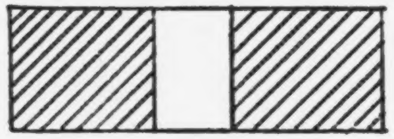
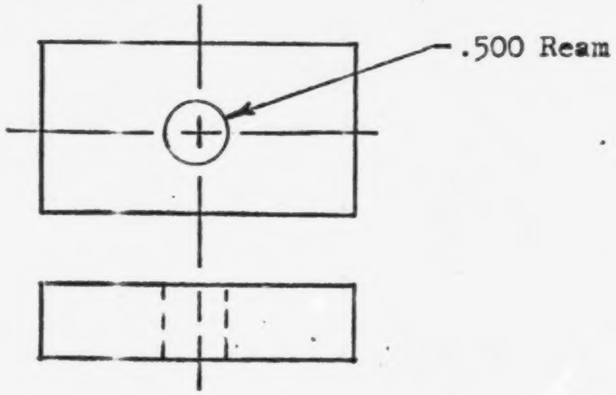
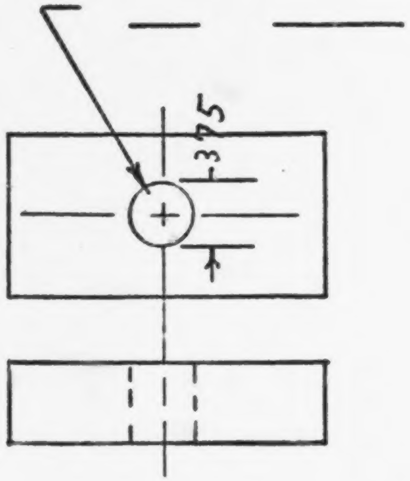
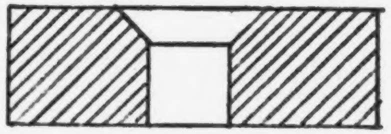
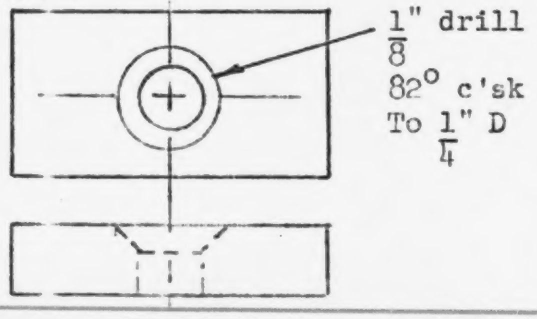
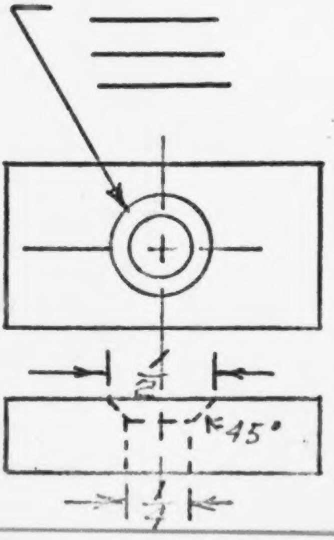
DIRECTIONS

FOR PROGRAMMED LEARNING PACKET

"NOTES ON BLUEPRINTS"

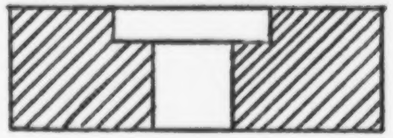
The material in this packet will help you learn to read and interpret blueprints. This packet is designed to teach you to read and understand the different kinds of notes found on blueprints.

Each page is divided into three sections, 1, 2 and 3. The first section describes a note or operation and gives the abbreviation for the term. The second section gives an example The third section gives a note that would be found on a drawing that you are to fill in with the proper numbers and words. When you answer the question, turn the third section back to see if your answer is correct When you have completed this packet return it to the teacher and take the post test.

1 **Drill:** To cut a round hole in a solid 	The note for a drilled hole gives the diameter of the drill. 	
2 **Ream:** To enlarge and finish an existing hole 	The note for a reamed hole gives the diameter of the reamer (usually in decimals) 	
3 **Countersink:** (c'sk)  To enlarge the top portion of a hole in the shape of a cone	The note for a countersunk hole gives: 1. Diameter of hole 2. The angle at which the hole is to be countersunk. 3. The diameter at the large end of the hole.  1/8" drill 82° c'sk To 1/4" D	

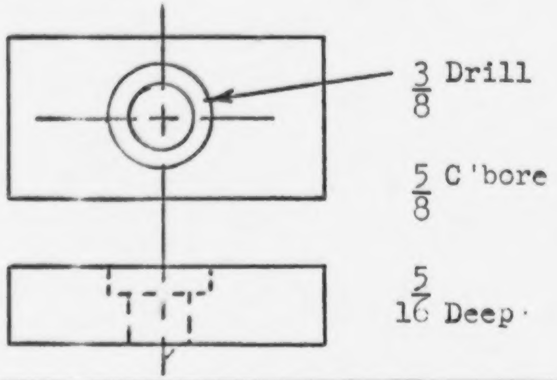
4

Counterbore:
(c'bore)

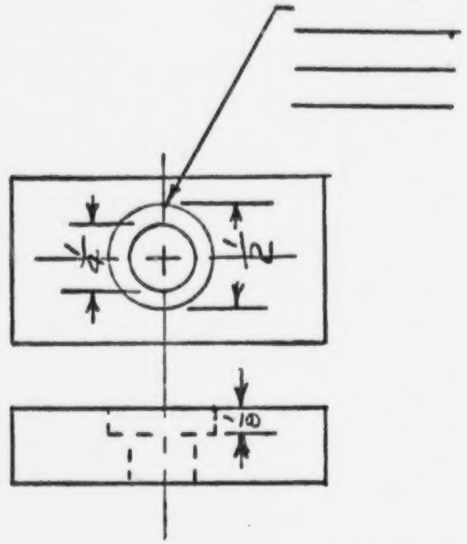


To enlarge a portion of a hole to a given diameter and a given depth

The note for a counterbored hole gives:
1. The diameter of the drill
2. The diameter of the counterbore
3. The depth



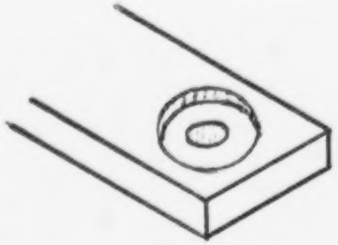
$\frac{3}{8}$ Drill
$\frac{5}{8}$ C'bore
$\frac{5}{16}$ Deep



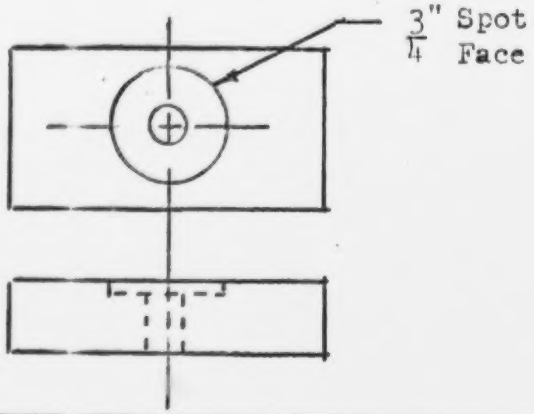
$\frac{1}{4}$
$\frac{1}{2}$
$\frac{1}{8}$

5

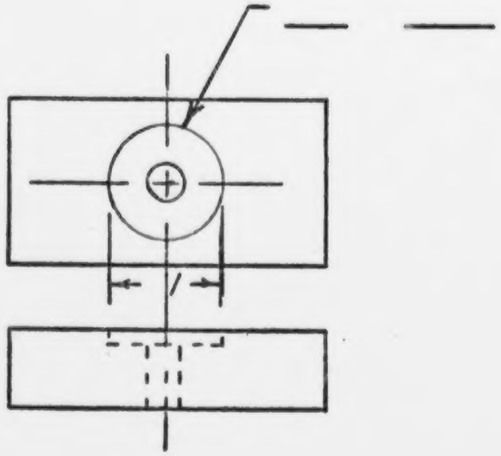
Spotface:
To face a spot encircling a hole



The note for a spot face gives the diameter of the faced surface

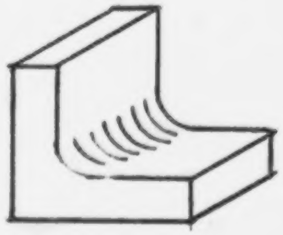


$\frac{3}{4}$" Spot Face

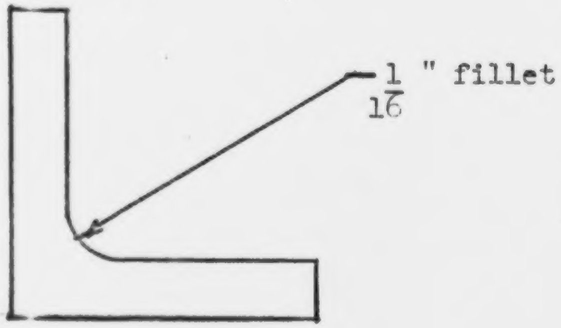


6

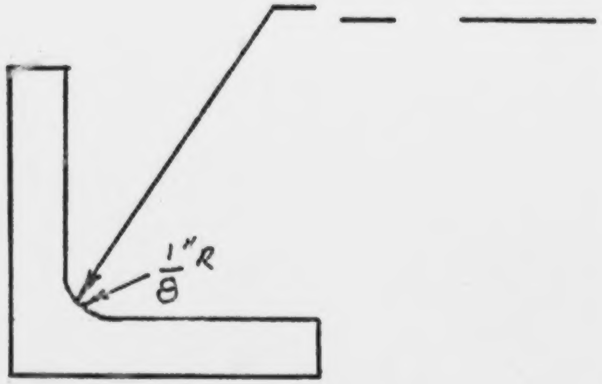
Fillet:
A small rounded inner corner



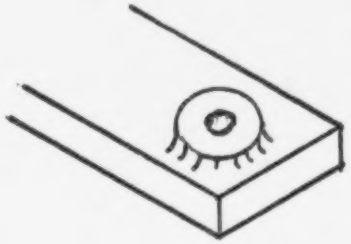
The note for a fillet gives the radius of the arc forming the fillet



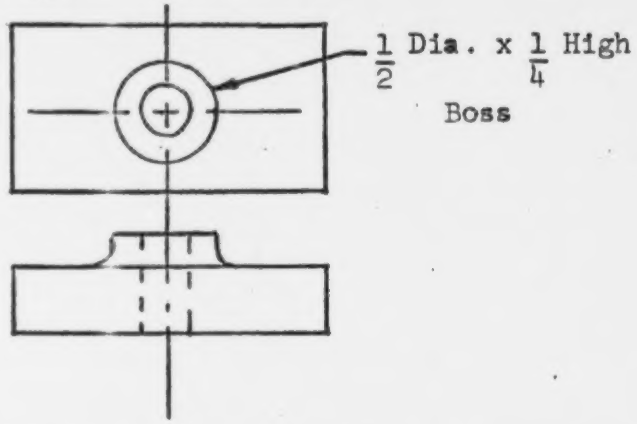
$\frac{1}{16}$ " fillet

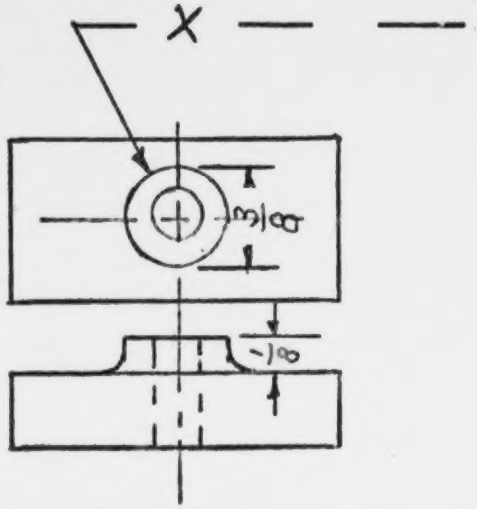


7
Boss:
A small part of a casting which projects above the main body

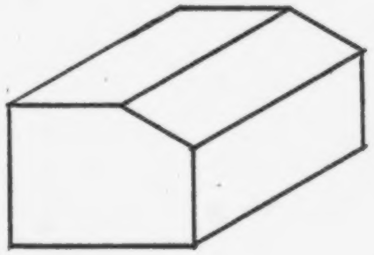


The note for a boss tells diameter and height

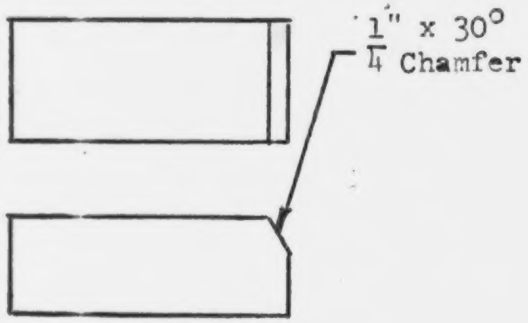

$\frac{1}{2}$ Dia. x $\frac{1}{4}$ High
Boss

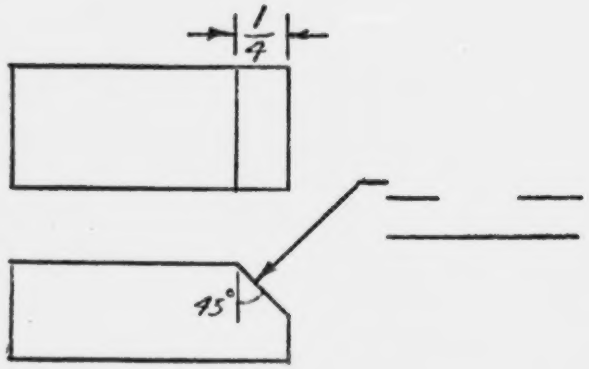


8
Chamfer:
The surface made by cutting away the square edge of any solid

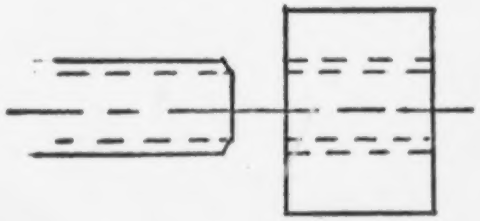


The note for a chamfer gives the size and angle

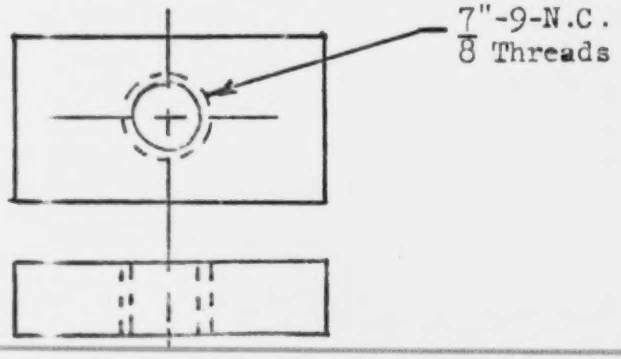

$\frac{1}{4}$" x 30°
Chamfer

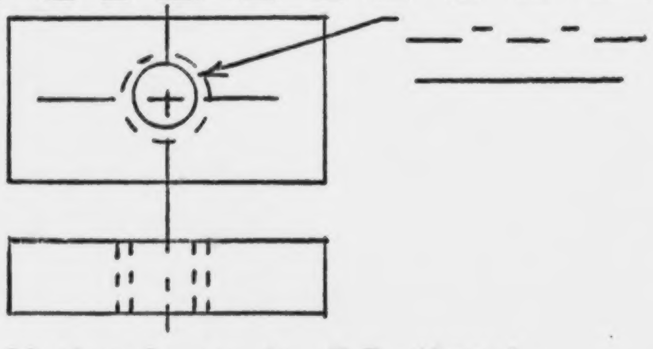


9
Screw Threads: (Thr'ds)
Screw threads are grooves cut on the inside or outside of solids so that they may be fastened together



The note for a thread gives:
1. The diameter of the thread
2. Number of threads per inch
3. National form thread
4. Thread series


$\frac{7}{8}$"-9-N.C.
Threads

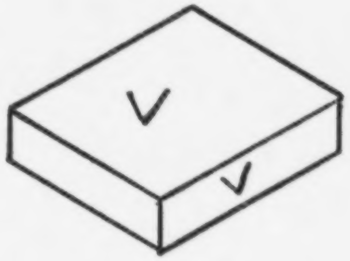


10 threads per in. N.F. thread
$\frac{1}{2}$ " thread

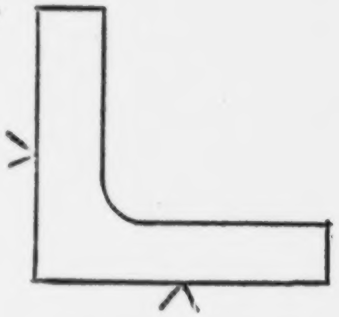
10

Finish Marks:

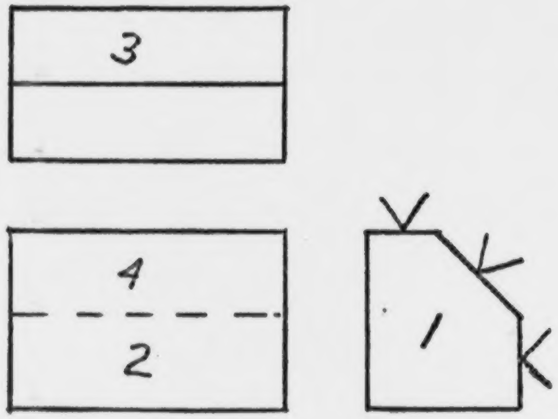
Surfaces that are machined to a smooth finish and to accurate dimensions are called finished surfaces. They are represented by a 60° V



Finish marks are placed on a drawing with the bottom of the V touching the surface to be finished



What surfaces of this block are to be finished?

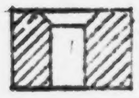


POST TEST

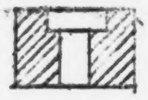
NOTES ON DRAWINGS

After each number, place the letter of the word that describes the example.

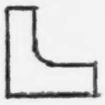
1. ____



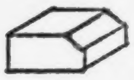
2. ____



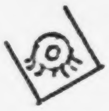
3. ____



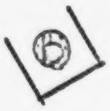
4. ____



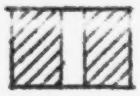
5. ____



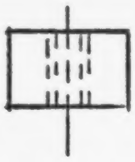
6. ____



7. ____



8. ____



A. DRILLED HOLE
B. FILLET
C. SPOT FACE
D. COUNTER BORE
E. BOSS
F. THREADS
G. CHAMFER
H. COUNTERSINK
I. FINISH MARK
J. REAMED HOLE

FOR THE STUDENT

No. E-25

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

DESIGNING A DRILL JIG

Objective:

Given the specifications of a part requiring holes to be drilled and the number of parts to be run, you will design a drill jig that will position the part on a drill press for the drilling operation.

Prerequisite:

In order to complete this activity, you must have basic skills in the operation of the drill press and in blueprint reading.

Activities:

Get three partners and work in groups of four. First, familiarize yourselves with the requirements (number of holes, size, and location) of the product. Next, you need to consider the characteristics of the drill press to be used. Using this information, discuss specific tasks to be performed and what device would aid in the performance of these tasks. Each person on the team will make several sketches of different devices that might satisfy the requirements. The group will then select the best design from all those submitted.

1. Familiarize yourself with the requirements of the part.
   a. Look at the drawing of the part.
   b. How many holes are needed in each part?
   c. Where are the holes located?
   d. What is the size of the holes?
   e. Are they all the same size?

2. Consider the features of the drill press you would use to drill these holes.
   a. What is the size of the table?
   b. Is there any provision for fastening things to the table?
   c. What is the distance from the column to the center of the drill bit?
   d. Will the chuck accept the drill bit size required by this part?
   e. Will the drill operate at the speed required by the material you are using?

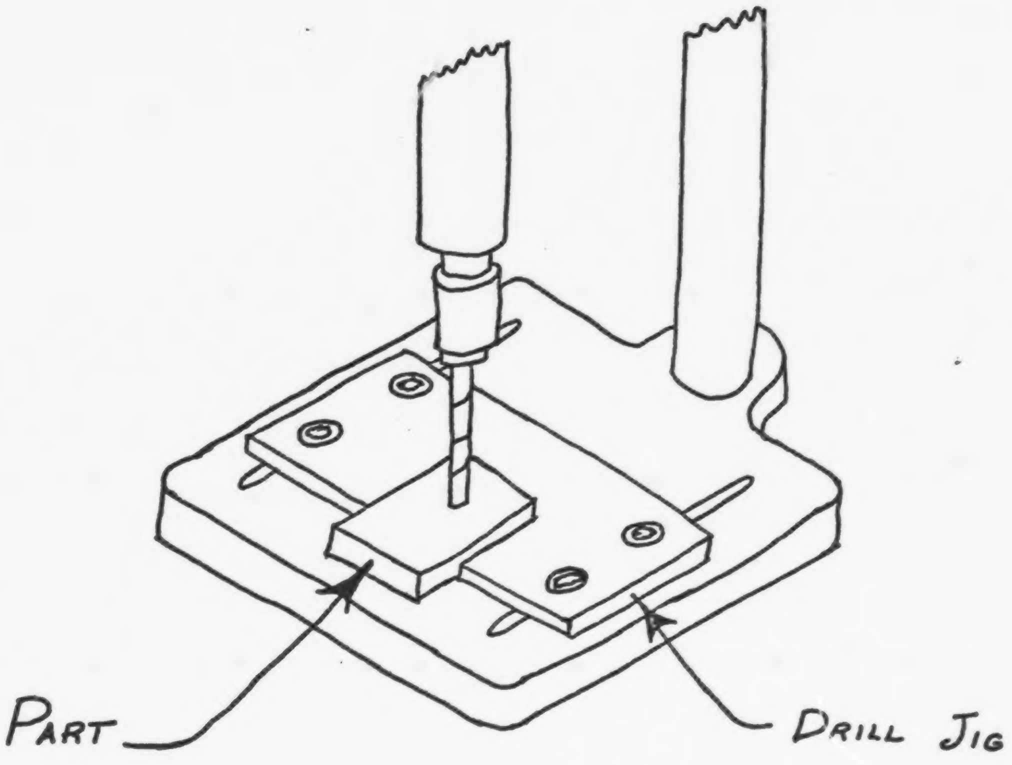
3. Form into groups of 4 or 5 students and --
    - a. Discuss how the holes would be drilled if only one part was to be made.
    - b. Talk about the operations of locating and holding the part.
    - c. Decide what kind of mechanical device would aid in locating and holding the part.
        - 1) This device would be callled a drill jig.

4. Work individually to make several sketches of different methods of holding and locating the part. The sketch shown below may be used as a guide to help you in this step.

5. After completing the sketches, re-assemble as a group and select the best design for a drill jig from all the sketches submitted.
    - a. The best design would be one that is easy to construct, will accurately position the part, will hold it securely for drilling, will be easy to use, and will not wear out before all the parts are drilled.

Post test:

Does the drill jig that you have designed locate the part on the drill press so that each hole is drilled in the right place?



FOR THE STUDENT No. E-26

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

THE JOBS OF TOOL AND DIE MAKERS: FABRICATING JIGS, FIXTURES, AND DIES

Objective:

After reading the material given in the Activity section, you will be able to answer the Post Test questions about what a Tool Maker does and what a Die Maker does.

Activity:

Read the following paragraphs describing the duties of Tool and Die Makers:

Jigs and Fixtures are special attachments designed and built for specific products and operations. They are fashioned by Tool Makers of wood, metal, plastic, fiber glass, or any other suitable material. These men are skilled craftsmen, capable of transforming the tool designer's blueprints into the hardware needed to manufacture a product. Their work may involve cutting, bending, welding or machining metal; cutting, glueing, planing, sanding and finishing wood; or working with plastics or fiber glass.

Dies and form blocks, used in drop hammers, forges, hydropresses, and stretch-forming machines are constructed by Die Makers. Often construction begins with a full-size plaster model from which castings are made. The castings are then machined to the exact specifications needed to form the part correctly. The machining is often done on tape-controlled milling machines. After the machining, the die must be finished by hand grinding and polishing until the proper degree of smoothness is achieved. This finishing is very tedious work. The Die Maker must be a patient and thorough workman.

Apprentice Training Programs are available in both Tool-Making and Die-Making areas, usually requiring a high-school diploma and a satisfactory score on an Aptitude Test.

Post Test:

Tool Maker

1. The Tool Maker makes special attachments designed and built for specific products and operations. These attachments are called _______ and _________________________.

2. List 4 materials a Tool Maker might use in the making of the Jigs and Fixtures.

   1)
   2)
   3)
   4)

3. What could a Tool Maker do to metal to make it into the proper Jig or Fixture? to wood?

Metal	Wood
a.	a.
b.	b.
c.	c.
d.	d.
e.	e.

Die Maker

1. What machines use dies and form blocks which are built by a Die Maker?

   1)
   2)
   3)
   4)

2. The casting often is made after the construction of a ______-_______ __________________ ___________________.

3. Then they are _______________________ to the exact specifications needed.

4. Finally, the die will be finished by _____________________ and _____________________ it by _ _______ until the proper degree of smoothness is achieved.

General

1. What 2 qualifications are necessary to enroll in Apprentice Training Programs to become a Tool or Die Maker?

FOR THE STUDENT No. E-27

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

IDENTIFYING GENERAL PURPOSE AND SPECIAL MACHINERY

Objective:

After studying the information in the following paragraphs, you will write 2 advantages obtained by using general purpose machines and 2 advantages obtained by using special purpose machines.

Activity:

Read the following paragraphs describing general-purpose and special-purpose machines.

> "The selection of tools and machines to be used in each phase of the manufacturing process is the responsibility of the Plant Engineer. There are two options available to the Plant Engineer or Tool Designer. First, he may purchase standing machines marketed by the machine tool industry, if they will perform the needed operations. Second, if standard machines will not satisfy the needs of his particular operation, the Plant Engineer must then design a special machine or tool and have it custom-built to his specifications.
>
> "There are two broad classes of machine tools in general use today -- General Purpose Machines and Special Purpose Machines. General Purpose Machines are standard machines regularly offered for sale by machine-tool builders. They are equally available to firms in various industries and are adaptable to specific uses in processing given products merely by varying the tooling used. When set up with different tooling, such machines will do two or more operations in the same plant, or they may be used by competing firms for similar or different operations, using appropriate tooling. In plants in different industries, they may be used for two or more unlike operations when properly tooled.[1] General Purpose Machines usually are less costly to purchase than Special Purpose Machines, but they are likely to be less productive, more costly to maintain, and need more highly skilled, higher-paid operators. A few examples of General Purpose Machines are: lathe, drill press, milling machine, shaper, planer, grinder, screw machine, arbor press, drop hammer, welding machine, and router.

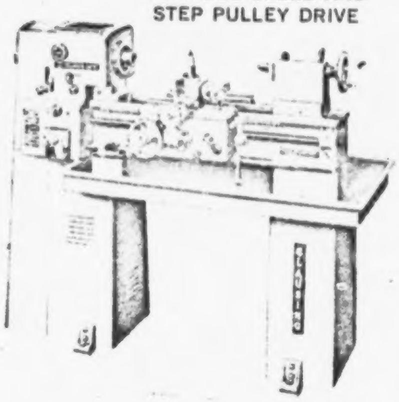
---

[1] H. N. Broom, Production Management, (Illinois: Richard D. Irwin, Inc., 1962), pp. 200-201.

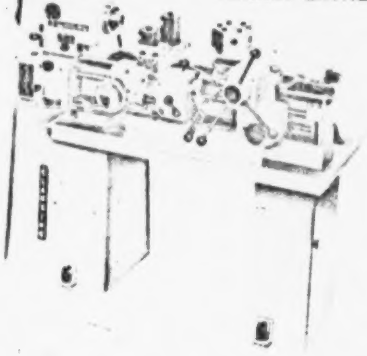
> "Special Purpose Machines are designed and built to perform a specific operation on a given product in a given plant. In all probability, even directly competing firms could not successfully use the same Special Purpose Machine. Certainly plants in other industries could not successfully adapt it to their use. Special Purpose Machines are inflexible, since they cannot be used for more than one operation. They are costly to design and construct. They are, however, generally heavier duty, faster acting, higher output machines than the General Purpose Machines available for doing the same operation. Thus, they justify their design and development cost by attaining higher output and lower unit of product cost.[2]

Here are some pictures of General Purpose Machines.[3]

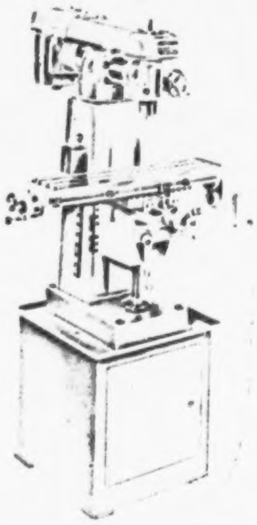
BACK GEARED LATHES. VARIABLE SPEED AND STEP PULLEY DRIVE



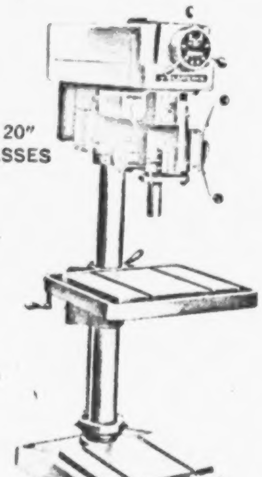
POWER FEED TURRET LATHES



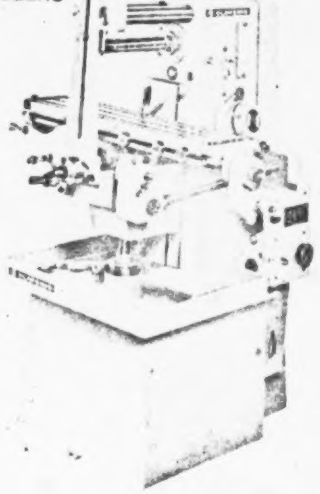
VERTICAL MILLERS



15" AND 20" DRILL PRESSES



HORIZONTAL MILLERS



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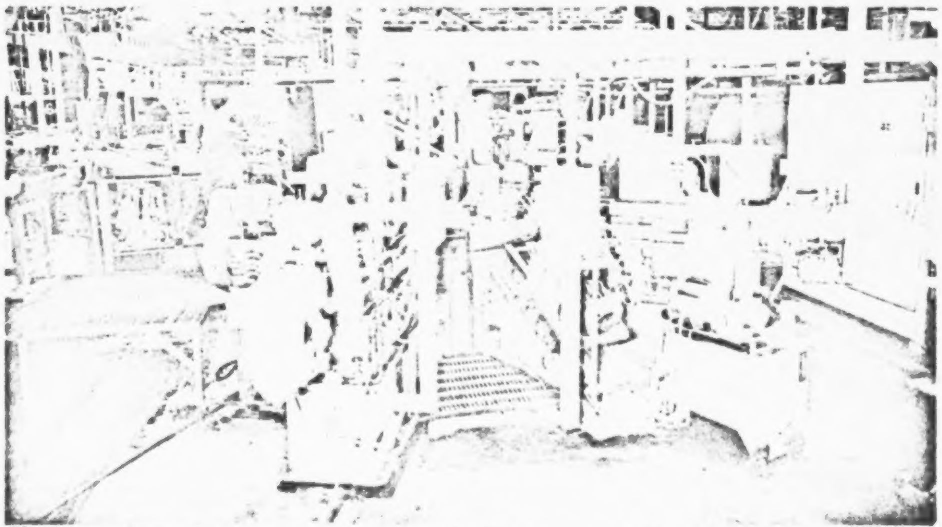
[2] Ibid., p. 213.

[3] Courtesy of The Clausing Company, Kalamazoo, Michigan.

The pictures below show you an example of a special machine. This machine is used in making transmission cases.

First section of the transfer machine with loading station in foreground. Note the large console with signal lights for every station along line.

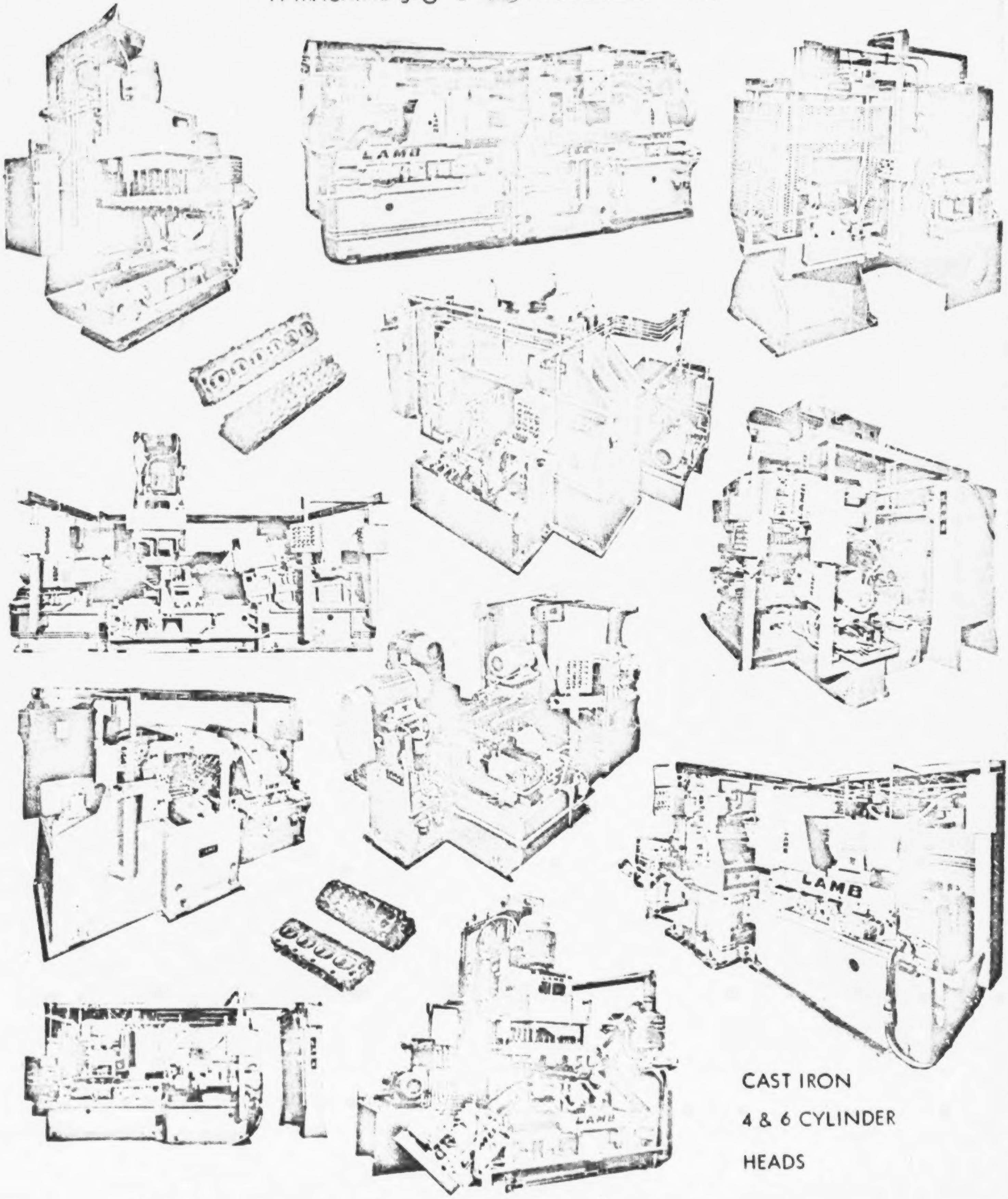


Close-up view of the five-station Lamb dial-type machine for producing initial locating operations before cases are shunted to the transfer machine.

Pictures courtesy of the F. Jos. Lamb Co., Detroit, Mich.

These pictures show special machines that are used to manufacture cast-iron cylinder heads.

11-MACHINE SEGMENTED PRODUCTION LINE



CAST IRON

4 & 6 CYLINDER

HEADS

Post Test:

1. In the spaces marked A and B write 2 advantages obtained by using General Purpose Machines.

   A.

   B.

2. In the spaces marked C and D write 2 advantages obtained by using Special Purpose Machines.

   C.

   D.

FOR THE STUDENT

No. E-31

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE LABOR COST OF ONE OPERATION ON THE DRILL PRESS

Objective:

Given that piece of your product that will require a drilled hole, a stop watch, a drill of the proper size, and drill press, you will estimate the labor cost of drilling one hole in this part.

Pre-requisite Skills:

Before attempting this activity, you must have passed the safety test on the drill press.

Activity:

1. Pick a partner.
2. Remove "Time Study" sheet from this package.
3. Get 5 pieces of stock that can be used to make this part from the teacher.
4. Locate and center punch 5 holes to be drilled.
5. Get a stop watch and permission from the teacher to use the drill press.
6. STOP - If you or your partner have not used the drill press see the teacher.
7. Get "C" clamps and proper size drill from tool rack.
8. Clamp stock to table.
9. Tighten drill in chuck (BE SURE TO REMOVE KEY).
10. CHECK YOUR CLOTHING - (Sleeves rolled, apron tied securely, all loose clothing tucked in.)

11. CHECK THE DRILL PRESS. (No one in safety zone, key removed from chuck, stock clamped to table.)

12. Start drill press.

13. Have your partner start stop watch.

14. Drill the required hole in the part.

15. Stop the stop watch.

16. Turn off drill press and clean with brush.

17. Record time on "Time Study" sheet (Trial 1).

18. You and your partner take turns using the drill press, and perform steps 8-17 until you have completed 5 trials.

19. Add the "Total Time" of trials 1-5 on "Time Study" sheet and divide by 5. This will give you the "Average Total Time" to perform this operation.

20. A machine operator earns about $3.75 an hour or about 63¢ a minute. Multiply this by the "Average Total Time" to get the "Computed Labor Cost of Operation".

21. Record "Computed Labor Cost of Operation" on "Time Study" sheet.

22. If you have any trouble with steps 19-21, see the teacher.

23. Finish filling out "Time Study" sheet.

24. Take parts and "Time Study" sheet to the teacher to be marked and recorded.

No. E-31

TIME STUDY

trial	start	stop	total time	remarks
1				
2				
3				
4				
5				
average total time ______				

Operation: ______

Date: ______

Operator: ______

Timer: ______

Labor Cost Per Hr.: ______

Labor Cost Per Min.: ______

Computed Labor Cost of Operation: ______

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE NO. E-31

Student packages E-31 through E-36 are time study packages for estimating the labor cost of a production product. These packages are representative of hand and machine operations. More packages would have to be developed for a complete labor cost analysis of a production product.

It would be advisable for the student to be familiar with the use of tools and machines before attempting these activities.

FOR THE STUDENT No. E-33

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE COST OF ONE OPERATION ON THE SCROLL SAW

Objective:

Given a piece of wood from your product that will require a scroll saw cut, a scroll saw, and a stop watch, you will estimate the labor cost of cutting that piece for production.

Pre-requisite Skills:

Before attempting this activity, you must have passed the safety test on the scroll saw.

Activity:

1. Pick a partner.
2. Remove the "Time Study" sheet from this package.
3. Get a piece of wood that can be used to make the required cut for this product.
4. Lay out the required curve on the wood. You should make a template for this operation.
5. Get stop watch and permission to use scroll saw from the teacher.
6. STOP - If you or your partner have not used the scroll saw, see the teacher.
7. CHECK YOUR CLOTHING - (Sleeves rolled, apron tied securely, all loose clothing tucked in.)
8. CHECK SCROLL SAW - (No one in safety zone, guards in place, hold down clamp properly adjusted, turn saw by hand.)
9. Start saw.

10. Have your partner start stop watch.

11. Cut your piece, as laid out for the product.

12. Stop the watch as soon as piece is cut.

13. Turn off and clean scroll saw.

14. Record time on "Time Study" sheet (Trial 1).

15. You and your partner take turns cutting and perform steps 8-14 until you have completed 5 trials.

16. Add the "Total Time" of trials 1-5 on "Time Study" sheet and divide by 5. This will give you the "Average Total Time" to perform this operation.

17. A machine operator earns about $3.75 an hour, or about 63¢ a minute. Multiply this by the "Average Total Time" to get the "Computed Labor Cost of Operation".

18. Record "Computed Labor Cost of Operation" on the "Time Study" sheet.

19. If you have any trouble with steps 16-18, see the teacher.

20. Finish filling out "Time Study" sheet.

21. Take parts and "Time Study" sheet to the teacher to be marked and recorded.

No. E-33

TIME STUDY

trial	start	stop	total time	remarks
1				
2				
3				
4				
5				
average total time ____________				

Operation: ____________

Date: ____________

Operator: ____________

Timer: ____________

Labor Cost Per Hr.: ____________

Labor Cost Per Min.: ____________

Computed Labor Cost of Operation: ____________

FOR THE STUDENT

No. E-34

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE LABOR COST OF ONE OPERATION ON THE BUFFER

Objective:

Given that piece of your product that will require buffing, a buffer, and a stop watch, you will estimate the labor cost of buffing this piece to the required lustre, with no burn marks, and no smears of buffing compound left on the metal.

Pre-requisite Skills:

Before attempting this activity, you must have passed the safety test on the buffer.

Activity:

1. Pick a partner.
2. Remove "Time Study" sheet from this package.
3. You and your partner get 5 pieces of that part of your product that will require buffing.
4. Make sure there are no rough edges or burrs on these parts. If there are, file them off.
5. Have teacher check parts before buffing.
6. Get stop watch and permission from the teacher to use the buffer.
7. STOP - If you or your partner have not used the buffer, see the teacher.
8. CHECK YOUR CLOTHING. (Sleeves rolled, apron tied, and all loose clothing tucked in.)
9. CHECK THE BUFFER. (No one in safety zone, buffing wheels tight.)

10. Start buffer. (Stand to side, use lower front of wheel to buff.)

11. Have partner start the stop watch.

12. Using a piece of scrap wood to back your part, buff the part to a high lustre. (No burn marks, no buffing compound left on metal, no lines, uniform lustre.)

13. Turn off buffer.

14. Stop the stop watch.

15. Record total time on "Time Study" sheet (Trial 1).

16. You and your partner take turns buffing and perform steps 10-14 until you have completed 5 trials.

17. Add the "Total Time" of Trials 1-5 on "Time Study" sheet and divide by 5. This will give you the "Average Total Time" to perform this operation.

18. A machine operator earns $3.75 an hour or about 63¢ a minute. Multiply this amount by the "Average Total Time". This will give you the "Computed Labor Cost of Operation".

19. Finish filling out "Time Study" sheet and take it, with the buffed pieces, to the teacher to be marked and recorded.

No. E-34

TIME STUDY

trial	start	stop	total time	remarks
1				
2				
3				
4				
5				
average total time ______				

Operation: ______

Date: ______

Operator: ______

Timer: ______

Labor Cost Per Hr.: ______

Labor Cost Per Min.: ______

Computed Labor Cost of Operation: ______

FOR THE STUDENT

No. E-35

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE LABOR COST OF SMOOTHING THE EDGES OF A PIECE OF SHEET METAL WITH A FILE

Objective:

Given a piece of sheet metal that will be part of your product, a file, and a stop watch, you will estimate the cost of labor to smooth the edges of this piece as required by quality control.

Pre-requisite Skills:

Before attempting this activity you must be able to:

1. Cut with tin snips.
2. Cut with a sheet metal shear.

Activity:

1. Pick a partner.
2. Remove "Time Study" sheet from this package.
3. Get five pieces of sheet metal that will be part of your product, from the teacher.
4. Trace template of your product piece on these pieces of sheet metal.
5. Cut to shape, using tin snips or shear as required.
6. Get stop watch from teacher.
7. Get mill file from tool cabinet.
8. Have partner start watch.
9. File edges of part you have cut out.
    - A. Remove all burrs.
    - B. File to lines.
    - C. Round edges.

10. When you have edges properly filed, have partner stop watch.

11. Have partner check edges.

12. If edges are properly filed, record time on "Time Study" sheet (Trial 1).

13. If edges are not properly filed, start watch and complete filing, then record time on "Time Study" sheet (Trial 1).

14. Have partner do steps 8-12.

15. Record his time on "Time Study" sheet (Trial 1).

16. You and your partner take turns filing the edges of the parts until you have completed 5 trials.

17. Add the "Total Time" of Trials 1-5 and divide by 5. This will give you the "Average Total Time" required to file the edges of this part.

18. A sheet metal worker earns $4.00 an hour, or about 67¢ a minute. Multiply this by the "Average Total Time". This will give you the "Computed Labor Cost of Operation".

19. Record "Computed Labor Cost of Operation" on "Time Study" sheet.

20. Finish filling out "Time Study" sheet and take it, with your filed parts, to the teacher to be marked and recorded.

No. E-35

TIME STUDY

trial	start	stop	total time	remarks
1				
2				
3				
4				
5				
average total time ______				

Operation: ______

Date: ______

Operator: ______

Timer: ______

Labor Cost Per Hr.: ______

Labor Cost Per Min.: ______

Computed Labor Cost of Operation: ______

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE LABOR COST OF ONE OPERATION ON THE SHEET METAL BRAKE

Objective:

Given the part for your product, requiring a bend on the sheet metal brake, a sheet metal brake, and a stop watch, you will estimate the labor cost of forming this piece, as required for your product.

Pre-requisite Skills:

Before attempting this activity you must have:

1. Completed Package E-35.
2. Satisfactorily used the sheet metal brake.

Activity:

1. Pick a partner.
2. Remove "Time Study" sheet from this package.
3. Get the parts that you cut out and filed (Package E-35) from the teacher.
4. Check your part with template to be sure your fold lines are properly marked.
5. Get stop watch from teacher.
6. Get permission to use sheet metal brake.
7. Check sheet metal brake for proper adjustment.
8. Have partner start watch.
9. Form part as required.
10. When finished have partner stop the watch.

11. Record "Total Time" on "Time Study" sheet (Trial 1).

12. Have partner do steps 7-10 and form his piece.

13. Record your partners "Total Time" on "Time Study" sheet (Trial 2).

14. You and your partner take turns forming parts until you have completed 5 trials.

15. Add the "Total Time" for the 5 trials and divide by 5. This will give you the "Average Total Time" to form this piece on the sheet metal brake.

16. Record this time on the "Time Study" sheet.

17. A sheet metal worker earns $4.00 an hour or about 67¢ a minute. Multiply this by the "Average Total Time" and you will have the "Computed Labor Cost of Operation".

18. Record "Computed Labor Cost of Operation" on "Time Study" sheet.

19. Finish filling out "Time Study" sheet and take it, with your parts, to the teacher to be marked and recorded.

No. E-36

TIME STUDY

trial	start	stop	total time	remarks
1				
2				
3				
4				
5				
average total time ________				

Operation: ________

Date: ________

Operator: ________

Timer: ________

Labor Cost Per Hr.: ________

Labor Cost Per Min.: ________

Computed Labor Cost of Operation: ________

No. E-40

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE COST OF MATERIAL TO PRODUCE ONE SINGLE UNIT OR ALL UNITS OF A PRODUCTION PRODUCT

Objective:

Given a model or a blueprint of your production product you will estimate the cost of material to manufacture one unit or all units of this product.

Activity:

1. Get model or blueprint of your product from the teacher.
2. Remove "Material Cost Estimate" sheet from this package. Note that the first three lines in all columns are examples to help you fill out this form.
3. List all parts required to make this product in Column A of material cost estimate sheet. (Be sure to include nails, rivets, solder, paint, varnish, etc.)
4. Have list checked by teacher.
5. Get price list of materials from the teacher.
6. Finish filling out material cost estimate sheet as follows:

   Column:

   B. List the number of parts required for each unit.

   C. List the kind of material for each part.

   D. List the size of each part.

   E. List the standard size of material that we can make this part from (e.g. wood 1" x 9" x 12' or metal 18 x 24).

   F. List the number of parts we can get from a standard size piece of material.

G. List the price of standard size of material (1 piece wood, 1" x 4" x 12').

H. Compute price per part (Column G divided by Column F).

I. List the number of units of your product that you will be making.

J. Compute the total material cost to produce enough of these parts for all of the units of your production product (Column H multiplied by Column I).

7. Repeat Step 6 for all of the parts required for your product.

8. Compute the material cost of all of the parts to produce one unit of your product (add all of the "costs" in Column H).

9. Compute the cost of all of the material required to produce all of the units of your product (add all of the "total costs" in Column I).

10. You now have estimated the cost of all of the material required to produce one unit or all of the units of your production product. If you have trouble with Steps 6-9 get help from the teacher.

11. Take your "Material Cost" sheet to the teacher to be marked and recorded.

MATERIAL COST ESTIMATE SHEET

A Part	B No. Req'd.	C Kind of Material	D Size	E Standard Size of Material	F No. of Pieces from Standard Size	G Price of Standard Size of Material	H Cost Per Part	I No. of Units Needed	J Total Cost
SIDE	2	WOOD	1"x1½X6	1"X4"X12"	48	\$1,60 PER. BD.	\$.03 X 2	200	\$12.00
SCREWS	6	STEEL	1"NO.9 F.H.	GROSS	144	\$.35 PER. GROSS	\$.002 X 6	200	\$2,90
CUTTER	1	BRASS	2"X6"	18"X24"	36	\$5,91 PER. SHEET	\$ .16	200	\$32.00

Total Cost Per Unit ________________(H)

Total Cost Per Units________________(J)

TEACHER'S REFERENCE INFORMATION SHEET FOR STUDENT PACKAGE E-40

To complete this package the student will need:

1. A model or blueprint of your production product.
2. A price list of materials that will include all of the materials that will be used in producing this product.

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING

ESTIMATE THE TOTAL COST OF PRODUCING ONE UNIT OR ALL OF THE UNITS OF A PRODUCTION PRODUCT

Objective:

Given a "Material Cost" form and "Time Study" forms for your production product, you will estimate the total cost of producing one unit of this product.

Pre-requisite Skills:

Before attempting this activity, you must have completed:

1. A time study for all the operations for your product (See pkgs. E-31 - 36).
2. Package E-40.

Activity:

To estimate the "total cost" of a product we must take into consideration all of the costs involved, such as fixed costs as well as actual manufacturing costs. The fixed costs are heat, light, rent, cost of machines, and tools. For our purposes we shall assume that our "plant" is already in operation and the tools and machines are available to us at no cost.

1. Get "Material Cost Estimate" sheet for this product . (Package E-40) from the teacher.
2. Remove "Labor Cost Per Unit" sheet from this package.
3. Get "Time Study" sheets for this product from the teacher.
4. From the "Time Study" sheets record the labor cost for each operation.
5. Add the labor cost for each operation and record the total labor cost on the bottom of the form.

E-41

6. Estimate labor cost for all units you wish to produce -- multiply total labor cost ("Labor Cost Per Unit" Sheet) by the number of units you are going to produce.

7. Estimate total cost to produce all of the units of your production product -- add "Total Material Cost" from Package E-40 to the total labor cost determined in Step 6.

8. Estimate total cost per unit of your product by dividing the amount that you computed in Step 7 by the number of units you wish to produce.

9. If you have any trouble with Steps 6-8 get help from the teacher.

10. Take your estimates to the teacher to be marked and recorded.

No. E-41

LABOR COST PER UNIT

PART	OPERATION	COST

Total Labor Cost: ______________________

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING

FILL OUT A REQUEST FOR QUOTATION FORM

Objective:

Given a model or a blueprint of your production product and a "Request for Quotation" form, you will determine what materials you will need to produce your product, and fill out a "Request for Quotation" form to be sent to various suppliers selling the materials you need.

Activity:

In purchasing materials for the manufacture of a product, you must determine what materials are needed and where these materials can be purchased most economically. To determine the best place to purchase your materials a "Request for Quotation" is sent to various suppliers describing exactly what is required. Each supplier then submits a price for these materials.

Sometimes a supplier cannot bid on all of the required items but we will list them all on the "Request for Quotation" so that they may bid on all of those they can supply.

1. Get model or blueprint of your product and a "Request for Quotation" form from the teacher.
2. On a piece of paper list all of the materials you will need to produce your product or use the list from package E-40.
3. On the "Request for Quotation" form, list the following:
    - A. If the bid is to be sealed (a sealed bid is one in which all bids are taken from sealed envelopes at the same time) mark X in square.
    - B. Last day bid can be returned to you.
    - C. If you have included blueprints (B/P) with your "Request for Quotation" mark X in square.
    - D. Name of supplier.
    - E. Street address of supplier.

F. City, state, zip code of supplier.

G. List any special instructions to bidders.

H. Item number from your blueprint.

I. How many you want.

J. Exact description of what you want.

K. Your name (you are the buyer).

L. The name of your company.

4. Go back over your list of materials and check to see that you have listed all of them in columns H, I, J.

5. Take your list of materials and "Request for Quotation" form to the teacher to be checked and marked.

Dat *MICHIGAN DIVISION*

[illegible]QUEST FOR QUOTATION

REQUEST FOR QUOTATION NO.

FILE NO. ____________

Ⓐ Ⓑ Ⓒ

BIDS MUST BE SEALED	RETURN NOT LATER THAN	PRINTS ATTACHED
☐ YES		☐ YES

THIS IS NOT A PURCHASE ORDER

Ⓓ

Ⓔ

Ⓕ

INSTRUCTIONS TO BIDDERS

1. IMPORTANT: BIDDER SHALL COMPLETE ALL AREAS CAPTIONED IN RED AND RETURN BUYER COPY.

Ⓖ

[illegible]

7. BIDDER IS INVITED TO MAKE RECOMMENDATIONS AND SUGGESTIONS WHICH WILL RESULT IN COST SAVINGS.

① ITEM NO.	QUANTITY	DESCRIPTION	DELIVERY DATE	UNIT PRICE
	②	③		
		NOTE: ALL EXCEPTIONS TO B/P MUST BE TAKEN AT THIS TIME. PLEASE REFER TO OUR FILE NUMBER AND SUBMIT IN DUPLICATE. IF UNABLE TO QUOTE, RETURN B/P.		

MAIL ALL CORRESPONDENCE TO THE ATTENTION OF BUYER

AT

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING

FILL OUT A PURCHASE ORDER

Objective:

Given a model or a blueprint of your product you will:

1. List all of the materials needed to manufacture this product or use list from package E-40, if you have completed E-40.

2. Fill out three purchase orders: one for wood, one for metal, and one for small parts.

Activity:

Before manufacturing a product it is necessary to determine what materials will be needed and purchase these materials. Because most suppliers specialize in one type of goods or materials, we will make out three "purchase orders" one each for wood, metal, plastics, glass, rubber and small parts. When purchasing materials from a vendor (the seller) we must be very careful to let him know exactly who is buying, what we want, how much or how many, when we want it, and where we want it. A properly written "purchase order" will tell the vendor these things.

1. Get a model or blueprint of your product, a "purchase order" form and 3 x 5 cards from your teacher.

2. List all the wood or lumber required for this product on one 3 x 5 card, all of the metal on a second 3 x 5 card and all of the small parts on a third 3 x 5 card.

3. Take the 3 x 5 card for wood or lumber, "purchase order" form and fill out the following:

   A. Who is purchasing (your company).
   B. How you want it shipped (truck, rail).
   C. Todays date.
   D. How vendor (seller) is to be paid (cash).
   E. What dept. needs this material (school shop).
   F. Where material is to be delivered.

G. Company that is selling you the material (vendor).
H. The quantity that you want of one particular item.
I. Material you will be using (2" x 4" 1" x 6" etc.)
J. The price of the material.
K. When you want this material delivered, and how much you want delivered on these dates.
L. Your name.

4. When you have completed this "purchase order" take it to the teacher to be checked.

5. Repeat Step 3 for all the metal that is required for your product.

6. Take "purchase order" for metal to the teacher to be checked.

7. Repeat Step 3 for all small parts that are required for your product.

8. Take "purchase order" for small parts to the teacher to be checked.

9. Take all "purchase orders" to the teacher to be marked.

SHIPPING DESTINATIONS:
1. 34201 VAN DYKE AVE., WARREN, MICH.

BUYER'S COPY

DAT *MICHIGAN DIVISION*

PURCHASE
ORDER NO.

D 0011

TPFC 2690D REV. (4-66)

SHIP TO Ⓐ 34201 VAN DYKE AVE. . WARREN, MICHIGAN	SHIP VIA Ⓑ	P.O. DATE Ⓒ	
F.O.B.	TERMS Ⓓ		
VENDOR CODE	MATERIAL CODE	REQUIRED BY Ⓔ	DELIVER TO Ⓕ

ES
BU INV
APP. REQ'D

VENDOR

Ⓖ

INVOICING ADDRESS IS

TRW MICHIGAN DIVISION
34201 VAN DYKE AVENUE
WARREN, MICHIGAN 48092

MAIL INVOICES TO ABOVE INVOICING ADDRESS IMMEDIATELY UPON SHIPMENT.
YOUR INVOICES MUST SHOW OUR CODE NUMBERS, IF SHOWN, OR THEY WILL BE RETURNED FOR CORRECTIO

QUANTITY	DESCRIPTION	PRICE
Ⓗ	Ⓘ	Ⓙ

Ⓚ

DELIVERY REQUIREMENTS	DATE	QUAN.	DATE	QUAN.	DATE	QUAN.	DATE	QUAN.	DATE	QUAN.

BUYER Ⓛ

PLANNING FOR PRODUCTION AND MANUFACTURING

DESIGN A "TRAFFIC ROUTE" FOR MATERIALS ENTERING A PLANT (SCHOOL SHOP), AND ROUTES FOR THIS MATERIAL TO REACH A POINT WHERE IT WILL BE USED

Objective:

Given a list of numbered work stations, where the first operation on each part of your product will be performed (Package E 44), a layout drawing of your shop (Package E 104), and colored pencils, you will design a "Traffic Route" for materials entering the production area of your shop, from the store room, to the initial starting point of production for each part.

Activity:

1. Get a drawing of the layout of your shop, (Package E 104), colored pencils, and the list of work stations (Package E 44) from the teacher.
2. On the drawing of the layout of your shop, number these work stations (Package E 44) using a different color for each material to be processed.
3. From the store room in your shop, or if the store room is not in the shop, from the door of the shop, draw a line, representing the route each material is to be moved to each of the numbered work stations, using the same color pencil for each material (Material No. 1, Red - use Red pencil). Draw line so that it does not interfere with other work stations or machines.
4. When you have completed all of the "Traffic Routes" in the shop, determine where in the school the materials will be delivered (store room, office, receiving dock, or door closest to the shop).
5. From the receiving point, make a sketch of the floor plan and trace a route for the materials to move to the store room.
6. When you have determined the "Traffic Routes", take your drawings to the teacher to be checked.

TEACHER PACKAGE INFORMATION FOR STUDENT PACKAGE E 45

To complete this package the student will need:

1. A drawing of the layout of the shop. (Package E 104).
2. Colored pencils.
3. List of numbered work stations from student Package E 44, if he has not completed Package E 44.

FOR THE STUDENT

E 46

PLANNING FOR PRODUCTION AND MANUFACTURING

ALPHABET OF LINES

Objective:

Given the programmed learning packet "alphabet of lines", you will identify the different kinds of lines found on a blueprint.

Activities:

1. Get the programmed learning packet "Alphabet of Lines" from the teacher.
2. Read directions on packet carefully.
3. Follow the steps in the package until you have completed all problems.
4. Get "Post Test" from teacher.
5. Complete "Post Test".
6. Return "Post Test" to teacher to be marked.

DIRECTIONS

FOR PROGRAMMED LEARNING PACKET

"ALPHABET OF LINES"

The material in this packet will help you learn to read and interpret blueprints. This particular packet is designed to teach you how different types of lines are used in blueprints.

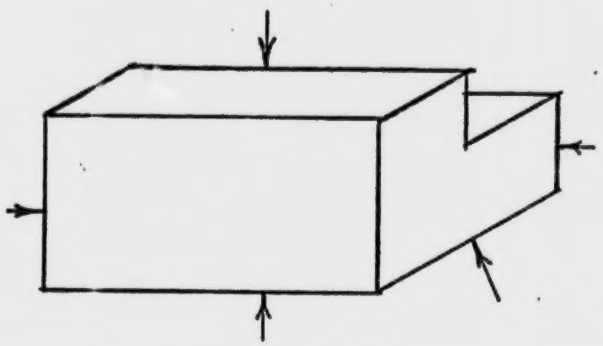
Each page is divided into three sections, 1, 2 and 3. The first section describes a line. The second section gives an example. The third section gives you a question. When you answer the question, turn the third section back to see if your answer is correct. When you have completed this packet return it to the teacher and take the Post Test.

1-1

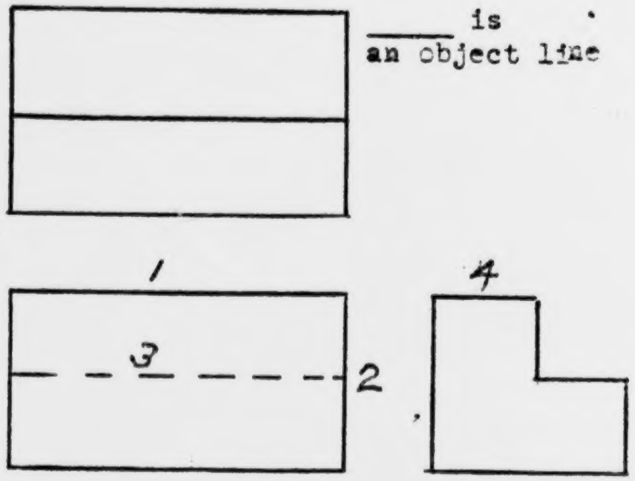
This is a visible line, or object line. It is a thick line and shows the shape of the object

1-2

Object Lines



1-3



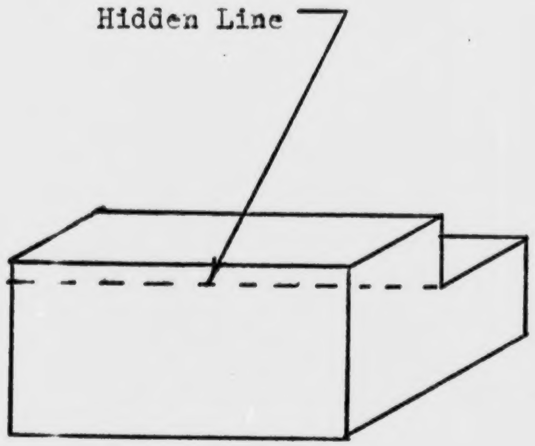
_____ is an object line

2-1

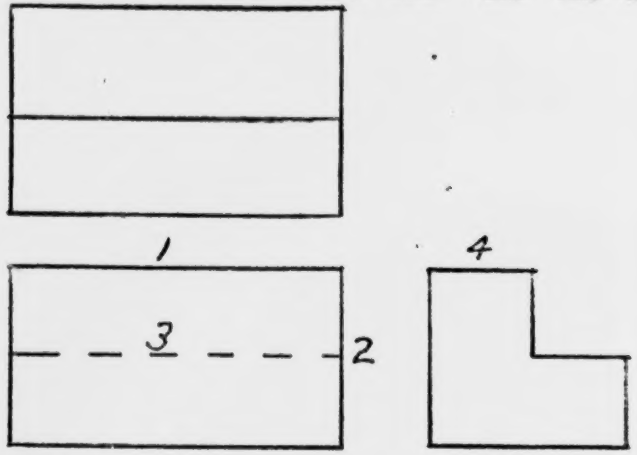
- - - - - - - - - - - - - - - - -

This is a hidden line. It is made of short dashes. It represents a hidden edge and is of medium thickness

2-2



2-3

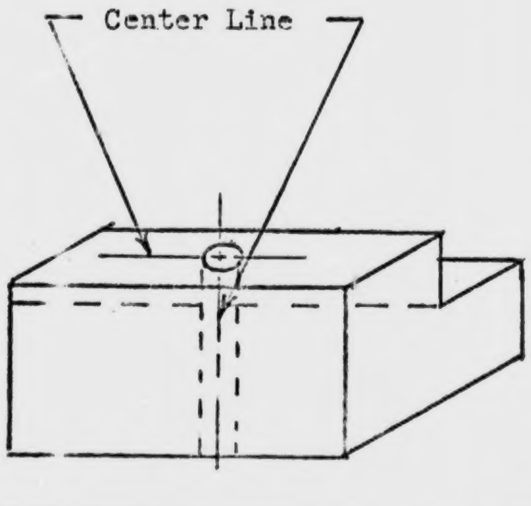


- - - is a hidden line

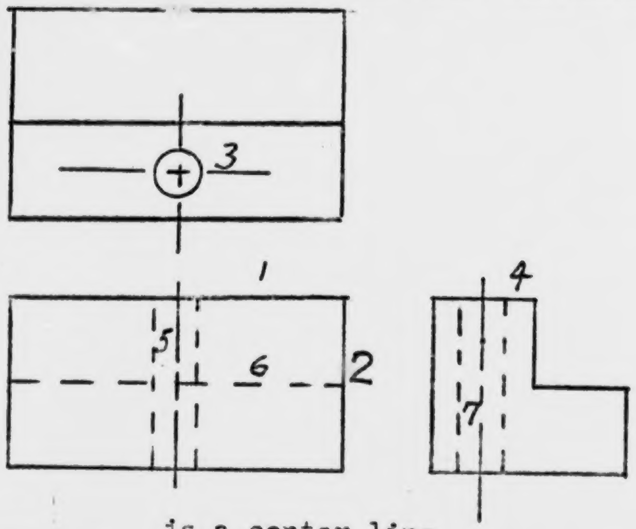
3-1

This is a center line. It is made up of long and short dashes alternately spaced. It shows the center of a hole or the center of a round object. It is a thin line.

3-2

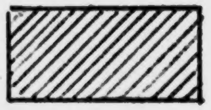


3-3



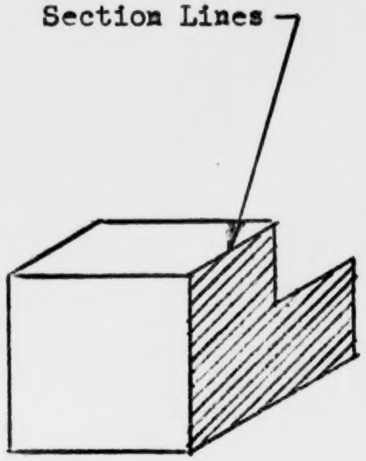
is a center line

4-1

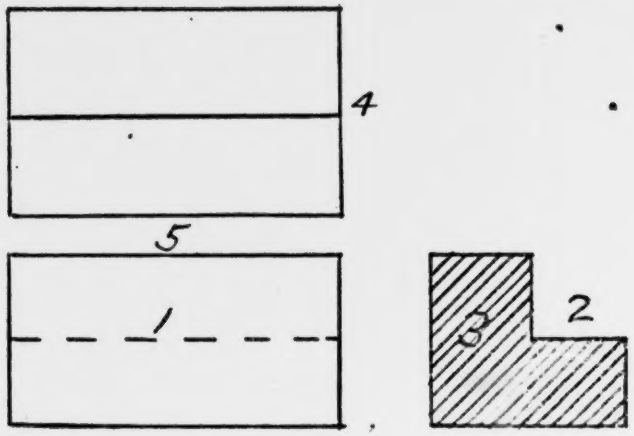


These are section lines. They are used to show what an object that has been cut through, looks like. A section line is thin.

4-2

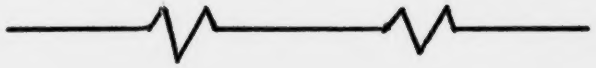

Section Lines

4-3



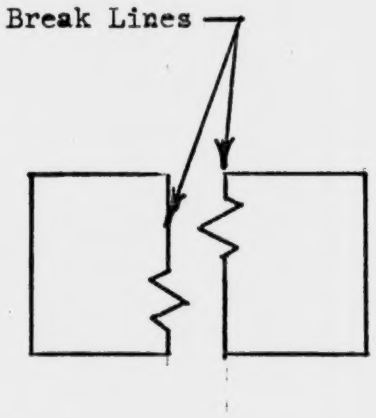
_____ is a section line

5-1

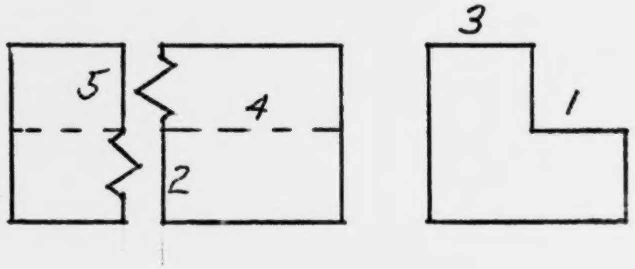


This is a break line. Break lines are used to show that the object is larger than pictured, but the drawing has been made smaller because of space. Break lines are thin lines.

5-2

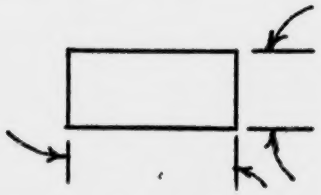

Break Lines

5-3



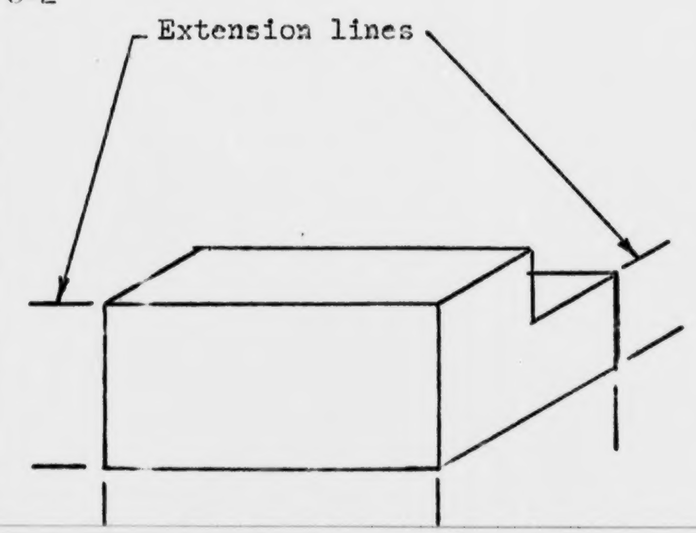
_____ is a break line

6-1

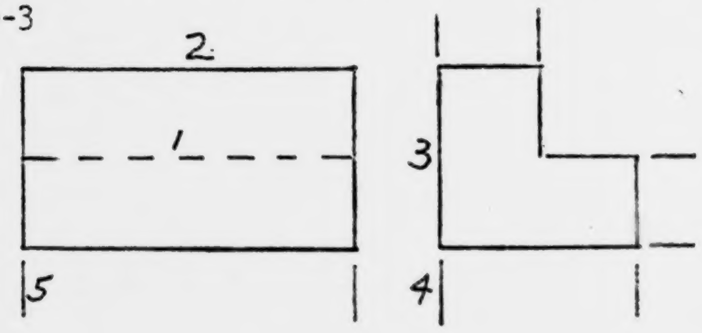


These are extension lines. They show what is to be measured. They do not touch object lines. Extension lines are thin lines.

6-2

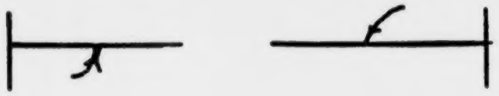

Extension lines

6-3



_____ is an extension line

7-1

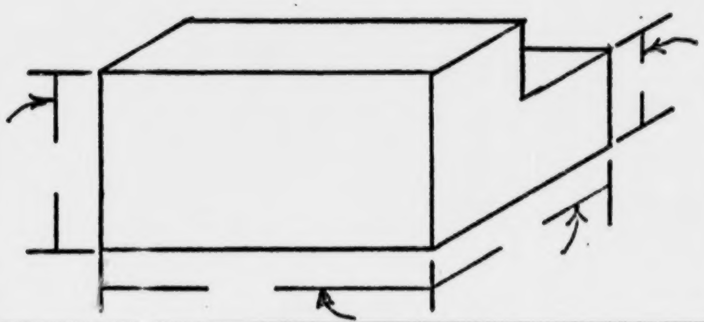


This is a dimension line. It should be at least $\frac{3}{8}$" from the object.

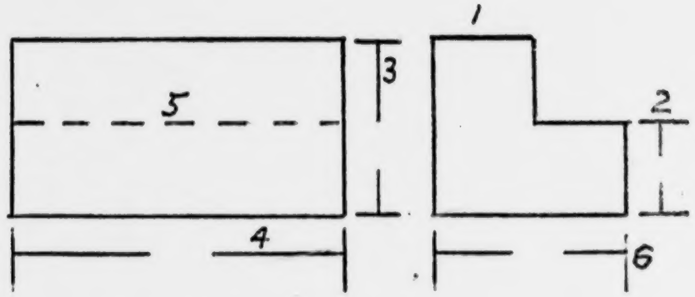
Dimension lines are thin lines.

7-2

Dimension Lines

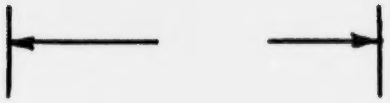


7-3



____ is a dimension line.

8-1

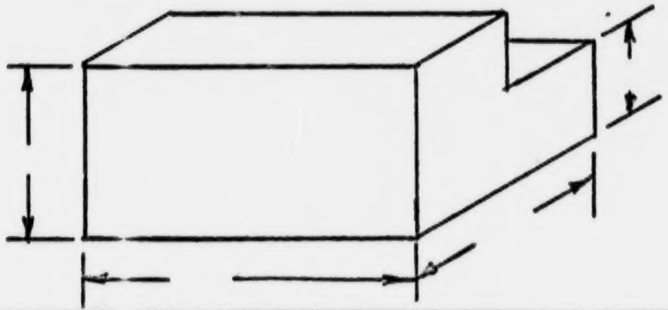


At each end of a dimension line is an arrow head. An arrow head is sharp and is 2 $\frac{1}{2}$ times as long as they are wide.

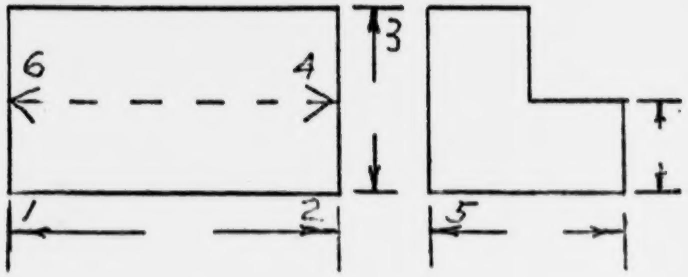
Arrow points touch the extension lines.

8-2

Arrow Heads

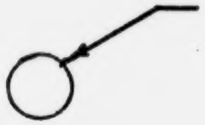


8-3



Which arrow heads are wrong?

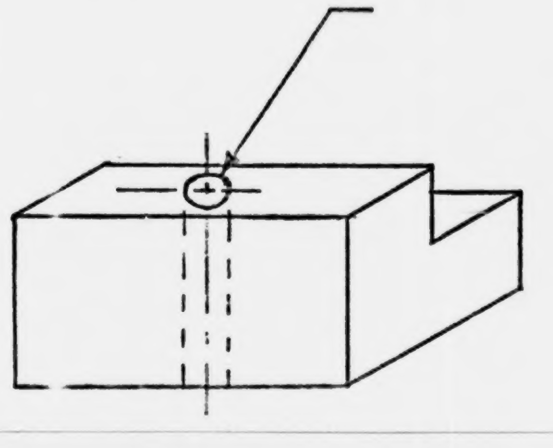
9-1



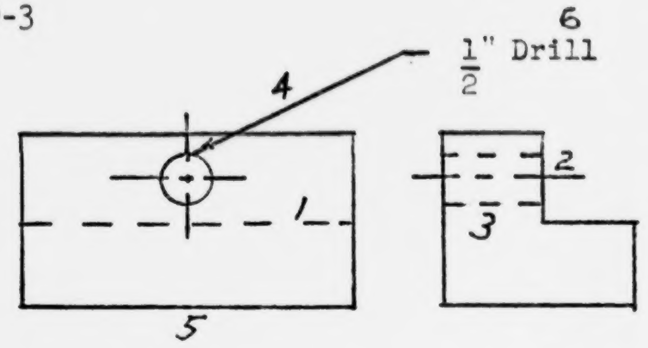
This is a leader line. It is used to show the size of holes or arcs. The arrow touches the outside of small arcs or holes. It is a thin line. With an arrow head at the end.

9-2

Leader Line



9-3

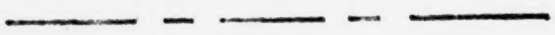


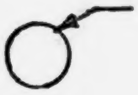
____ is a leader line

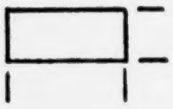
POST TEST

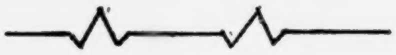
ALPHABET OF LINES

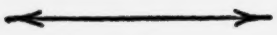
After each number, place the letter of the proper name of that line.

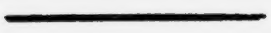
1. ____


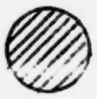
2. ____


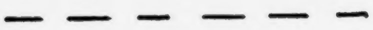
3. ____


4. ____


5. ____


6. ____


7. ____


8. ____


A. VISIBLE OR OBJECT LINE
B. HIDDEN EDGE LINE
C. CENTER LINE
D. SECTION LINES
E. BREAK LINE
F. DIMENSION LINE
G. EXTENSION LINE
H. LEADER LINE
I. DRAWING LINE

FOR THE STUDENT

No. E-53

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

DEFINING AUTOMATION

Objective:

After studying the information given in the Activity section which follows, you will be able to tell your teacher or others in your group what "automation" means and you will be able to describe some automated processes you know about.

Activity:

Read the following definition of the term "automation" and the examples that follow, and then show mastery and understanding by completing the Post Test activities.

> "Automation is the replacement of human supervision of machines and mechanized processes by automatic supervision.[1]" Such automatic supervision must involve every step in the process. In other words, the automated machine can "think for itself" and can perform all the work without human help.

No one has yet developed a fully-automated factory, nor is it likely to happen soon. But we can say we are seeing automation in each change or replacement of human supervision by an automatic process of supervision.

An example of automation would be the thermostat. For instance, the thermostat connected to your furnace works without human supervision. After it has been set at the temperature desired, the thermostat is able to sense a drop in temperature and can "turn the furnace on". When the furnace has heated the house back up to the desired temperature, the thermostat "shuts the furnace off". The thermostat in your hot water tank keeps your water as hot as you want and the thermostat in your oven can turn your oven on and off to cook a meal automatically.

Mechanized processes are constantly being improved as scientists and engineers strive to make devices and machines that are completely automatic. By pushing buttons, you can now clean ovens automatically, defrost refrigerators automatically, or wash dishes automatically. These are only semi-automatic processes, it is true, but how much more removed from human supervision they are then the actual manual labor formerly required to perform these duties.

---

[1] David Foster, Automation in Practice. (London: McGraw-Hill Book Co., 1968, p.4.

Other semi-automatic processes or machines might be: an automatic elevator or an automatic pin-spotter in a bowling alley.

Post Test:

1. In your own words, write a definition or description of the term "automation".

   Automation is ____

   ____

2. List the 8 automatic and semi-automated processes or machines mentioned in the Activity section, then list 2 additional processes or machines that you can think of. Remember: there are varying degrees of automation, with only a few processes being completely automated, so semi-automatic processes are acceptable.

   1.
   2.
   3.
   4.
   5.
   6.
   7.
   8.
   9.
   10.

TEACHERS' REFERENCE INFORMATION FOR STUDENT PACKAGE NO. E-53

Some answers acceptable for Post Test Question 2.

From reading material:
- thermostat on hot water tank
- thermostat on furnace
- thermostat on oven
- dishwasher
- defrosting your refrigerator
- cleaning oven
- automatic elevator
- automatic pin-spotter in bowling alley

Other acceptable answers:
- an automatic dryer, esp. those which are made to sense dampness
- an automatic door opener
- automatic pilot used to fly airplanes
- automatic controls on cameras which sense light, distance, etc.
- automatic dimmer switches on automobiles
- automatic transmissions on automobiles
- automatic food dispenses (e.g., automats)
- automatic washers, esp. those which can add bleach, water softeners, etc., at a pre-determined time
- automatic ice makers in refrigerators
- dehumidifiers
- airconditioners

FOR THE STUDENT No. E-54

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

DEFINING NUMERICAL CONTROL

Objective:

After reading the following paragraphs, you will write on paper the functions of the teleprinter and the control console.

Activity:

Read the material below and then complete the Post Test questions to test your understanding of what you have read.

"Numerical control is a form of automation relating to the use of digital computers to control the operation of machine tools like the milling machine."[1] Numerical control shows that information on an engineering drawing is reduceable to numbers, which specify the important points in a component. By using a system such as punched tape, these numbers can be fed to a control system as "command information" -- i.e., information stating where certain moving parts of the machine tool should be -- the desired position. For control purposes, there must also be another tape with similar information about the actual position of the parts so that the actual and desired positions may be compared and any differences (or errors) can be used to make the proper correction.

In a typical situation the information from the engineering drawing is fed into a teleprinter, which punches a series of holes in a paper tape. This tape is placed on the console of the machine tool to be used. A computer built into the machine translates the information contained on the punched tape into command information which causes the machine to function in such a manner as to create the part specified on the initial engineering drawing.

A more familiar example which might help you understand this cycle of "numerical control" would be a player-piano roll. The piano player "makes" the roll by playing a song on a special piano which has a device attached to each of the 88 keys on the piano that will punch a hole in an appropriate space on a roll of paper when a particular note is struck. As the roll winds from one spindle to the other, the following things happen:

---

[1] David Foster, Automation in Practice. (London: McGraw-Hill Book Co., 1968, p. 68.

The Engineering Data	song
is fed into the teleprinter,	played on the piano by the piano player
which punches the information	notes (holes)
on a paper tape	piano roll.
Then, when the paper tape	finished piano roll
is fed through the control console,	is attached to the player piano and started through the process of winding from one spindle to the other,
the paper tape	piano roll
acts in such a manner	the holes punched in the piano roll line up with holes in a spindle over which the roll moves to control the keys
as to cause the machine tool to perform whatever work is necessary	each hole causes a hammer to strike a note on the piano
to produce the finished product or part	the song is played by the use of notes just as if a person was actually moving his fingers on the keys to make them strike.

Post Test:

1. What is the job done by the teleprinter?
2. What does the control console do?

FOR THE STUDENT No. E-56

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

WORKING WITH PUNCH CARDS

Objective:

Given a blank punch card, you will indicate the spaces that would be punched out to spell out your name and address.

Activity:

Read the following paragraphs and look at the picture of a punched card. Then complete the activities listed in the Post Test.

Of the several punch card systems on the market today, the system produced by the International Business Machine Corporation (IBM) is the most widely used. Probably most of you have seen an IBM card and wondered what the holes punched in it meant. Look at the picture of the IBM card on the next page and find the parts talked about as you read the following explanation.

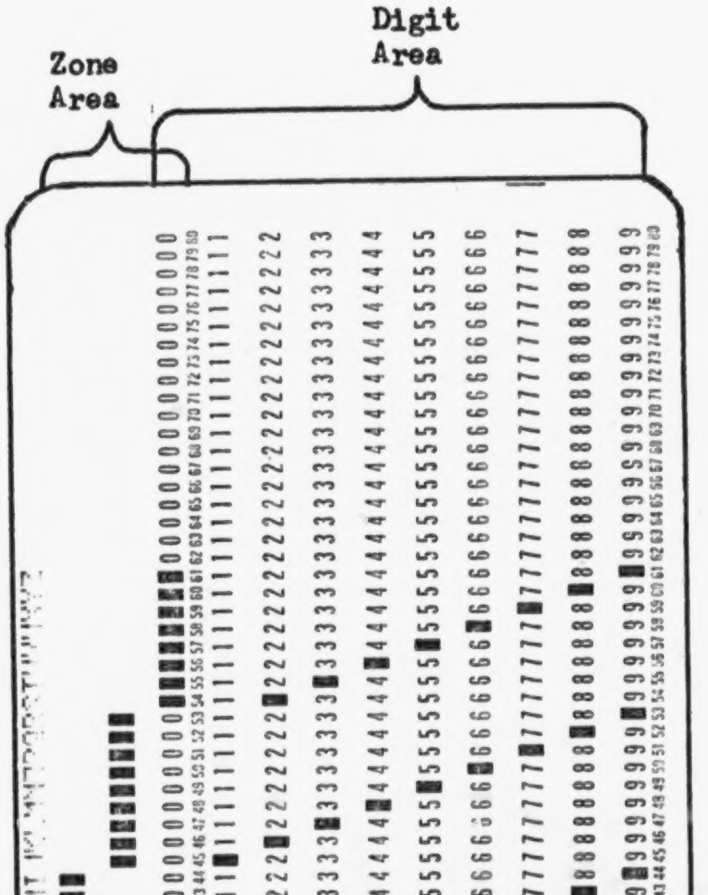
The machine code used to store information on an IBM card is referred to as the Hollerith code. Dr. Herman Hollerith devised the technique of storing certain data in a standard-sized card by following a predetermined code to punch holes in specific locations on it.[1]

The IBM card is divided into eighty vertical spaces called columns. The columns are numbered horizontally from left to right: one to eighty. In each column one letter, one digit, or a special character can be stored, making a total of eighty characters per card. For example, suppose we wish to punch in a card employee number 40875. Because each column can store only one character, five columns would be required to store 40875. In fact, any five consecutive columns in the card would qualify. If we decided to use the first five columns for that purpose, then digit 4 would be punched in column one, digit 0 in column two, digit 8 in column three, digit 7 in column four, and digit 5 in column five.[2]

---

[1] Elias M. Awad, Business Data Processing, 2nd Ed. (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1968), p. 86.

[2] Ibid., p. 84.


Zone Area
Digit Area

In addition to the card's eighty vertical columns, the IBM card is also divided into two punching positions: (1) the zone punching position, and (2) the digit punching position.

The zone punching position consists of three horizontal rows, two of which are used for zone punching only. They represent the gap on the top of the card. The first row from the top is called row twelve. The next one, row eleven, is commonly called the "X row." One punch in row X (referred to as X punch) in a selected column (one to eighty) is often used to distinguish a given card(s) from the remaining cards of the deck. The third row is known as the "zero row" and can be used either as a zone punching position or a digit punching position.

The digit punching position consists of ten horizontal rows, numbered vertically, to accommodate the digits 0-9 which correspond to the printed numbers on the card. Row zero accommodates digit 0; row one, digit 1; row two, digit 2; and so forth.

Numbers are recorded in a card by punching only one hole in a column for each digit. If we need to store, for example, a nine-digit serial number in a card, it would require nine holes in any nine consecutive columns. The punched holes are made in the digit punching position.

If alphabetic data are to be recorded, it requires two holes in any column for each letter of the alphabet. For example the word HORSE punched in a card requires five consecutive columns with two holes in each. One must be in the zone punching position and the other in the digit punching position. In other words, one hole is required to store a digit in a column, while two holes are required to store a letter in that column. This technique is standard on all IBM cards and is based on the Hollerith theory of machine coding.[3]

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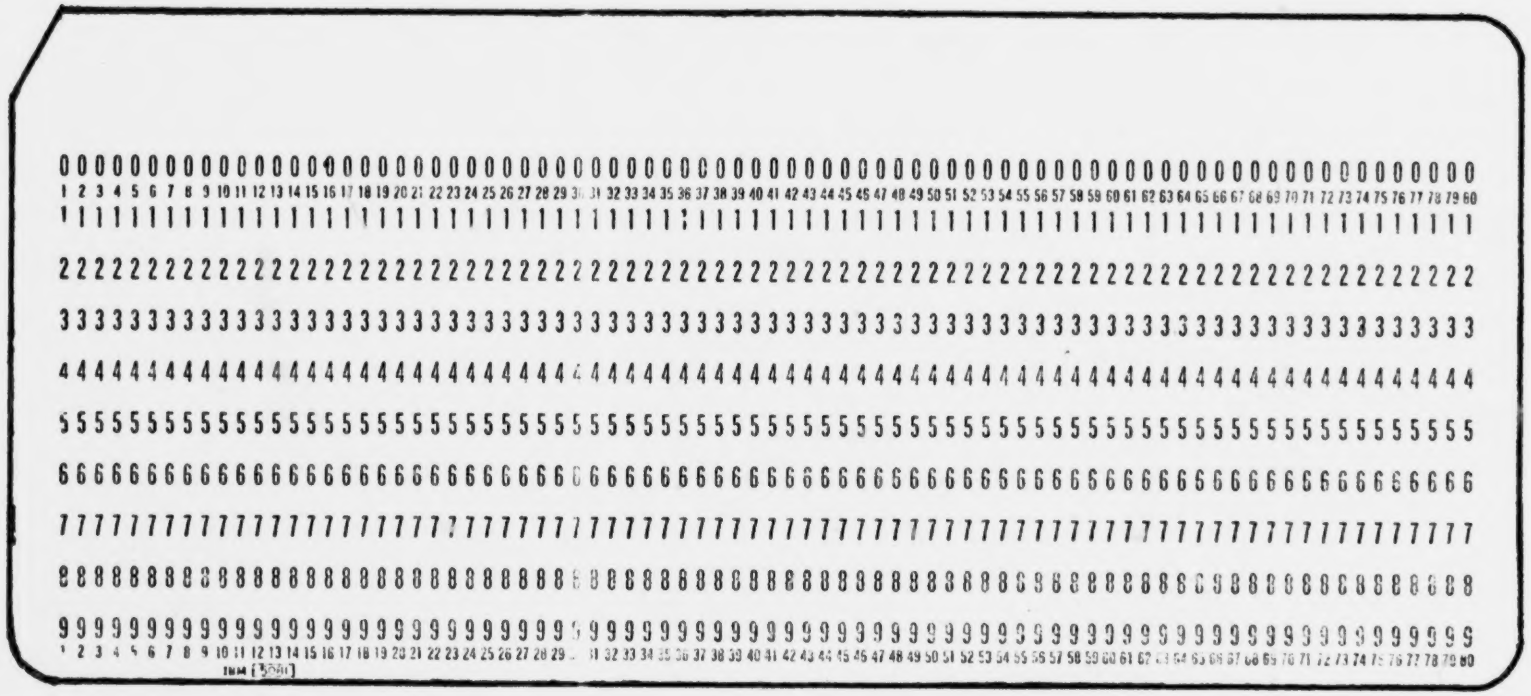
[3] Ibid., pp. 84-86.

Numbers are punched in the row printed with the number that you want. Letters are punched according to the following table.

Letter	Zone Punch in Row	Digit Punch in Row
A	12	1
B	12	2
C	12	3
D	12	4
E	12	5
F	12	6
G	12	7
H	12	8
I	12	9
J	11	1
K	11	2
L	11	3
M	11	4
N	11	5
O	11	6
P	11	7
Q	11	8
R	11	9
S	0	2
T	0	3
U	0	4
V	0	5
W	0	6
X	0	7
Y	0	8
Z	0	9

Post Test:

Using this table and a blank IBM card, darken in with a pencil the spaces that would be punched to record your name and address.


IBM 5081

FOR THE STUDENT No. E-58

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MAKING A TIME-KEEPING RECORD

Objective:

Given the necessary information about jobs worked on and time spent on each job, you will be able to record the information in the proper space on the form provided.

Activities:

In order to determine the cost of labor in a manufacturing operation, records must be kept showing the amount of time the workers spend on each job. Usually each worker makes a record of his own time on a daily or weekly time card. Sometimes this card is used to compute the amount of pay for the worker, as well as for figuring the cost of each job.

Units of time differ greatly, depending on the nature of the work involved. In some cases, time is recorded in units of days, figuring 8 hours in 1 working day. In other cases, time is recorded in tenths of an hour or six-minute segments. For this lesson we will make 1 hour the smallest unit recorded.

Look at the sample time card shown on Page 2. Notice that the first column at the left side of the card is for Thursday. The card is made this way because this particular company collects the cards at the end of the shift on Wednesday so they may be processed and the worker's pay calculated and made ready for distribution to the worker on Friday. The date entered at the top of the card in the space marked "Week Ending" is that of Wednesday, the last day recorded on that card. Under the column headed "Work Item", you write a brief description of the work being done. The column headed "Project" is used to identify the customer or contract for which the job was done. The columns headed "Oper.", "Job", and "Appro." are filled in by the Accounting Department to further classify which account the job should be charged to. The column at the far right, headed "Amt." is usually filled in by a person in the Accounting Department and is the total amount of money to be paid the worker for that particular job for the week indicated on the card.

Line 1 shows the first job the worker did when he started to work on Thursday -- shearing #5127 panels for Project #723. He worked on this job 3 hours.

Line 2 tells us that his next job was drilling name plates for Project #537. This job took 2 hours.

TIME RECORD — Week Ending FEBRUARY 4, 1970

Name GEORGE SMITH

	Thu.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Total	Work Item	Project	Oper.	Job	Appro.	Amt.
1	3							3	SHEARING #5127 PANNELS	723				
2	2							2	DRILLING NAME PLATES	537				
3	3	4						7	DRILLING FLANGE BRACKET	382				
4		4						4	FOLDING END CAPS	741				
5					6			6	DRILLING ANGLE PLATES	723				
6					2	2		4	SHEARING #4232 STRAPS	723				
7						4		4	SHEARING # 1476 BRACES	421				
8						2		2	FOLDING # 2188 STRUTS	421				
9							8	8	SHEARING # 1659 BRACES	354				
10														
11														
12														
	8	8			8	8	8	40	**Continue additional items on reverse side of card.**					

Total Time 40 **Rate** **Pay** **Approved**

5M-9-62

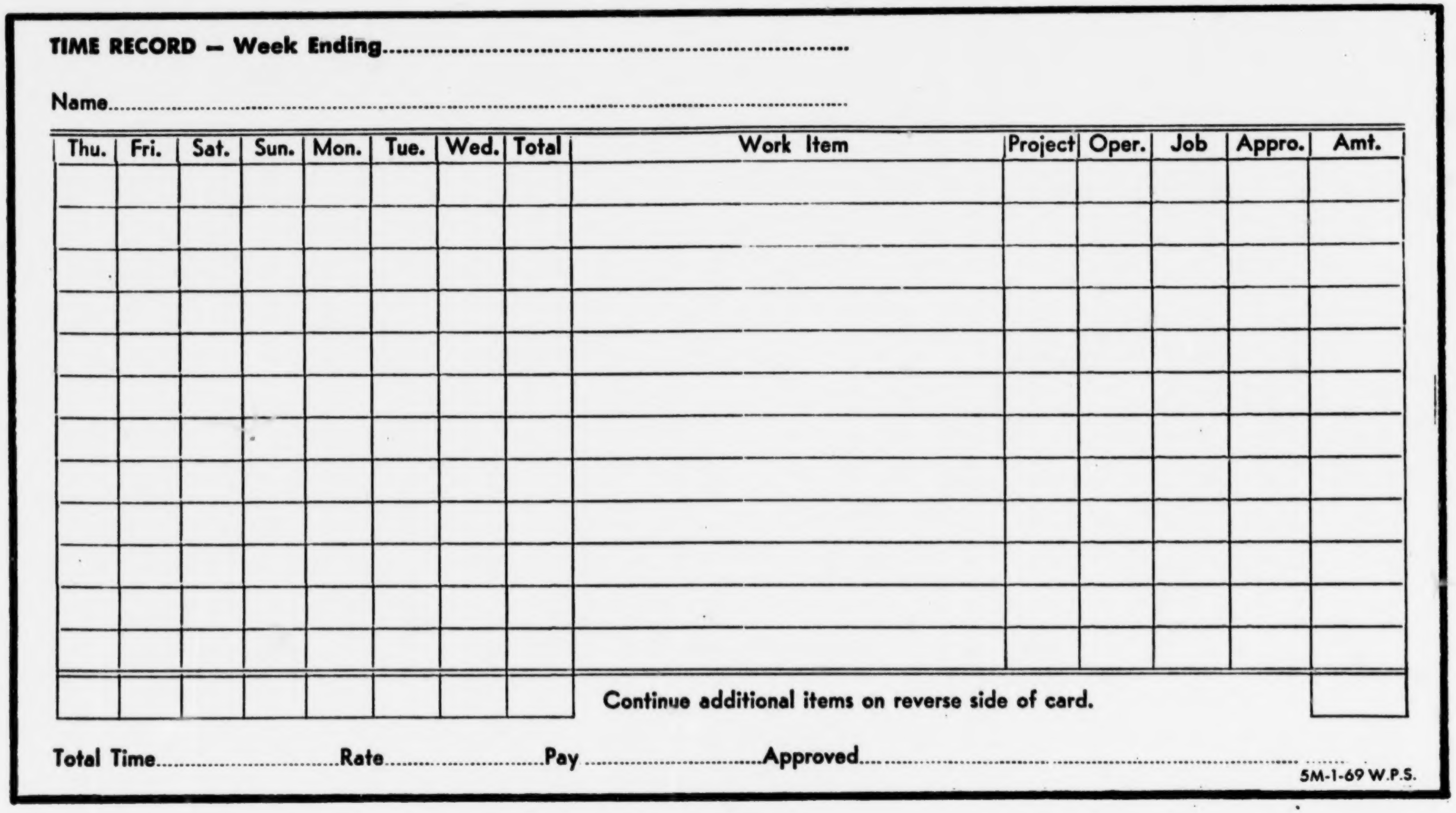
He finished the day working on drilling flange brackets for Project #382, which took 3 hours, as shown on Line 3.

On Friday, he spent 4 hours again drilling flange brackets, so this 4 hours is entered on Line 3 in the column for Friday.

Each job is recorded in this manner for the entire week. The total time for each line is entered in the column headed "Total". The total time for each day is recorded at the bottom of the column for that day. When the totals for each job are added, the sum should be the same as those shown when the totals for each day are added. Enter total time in the space indicated at the bottom of the card. The spaces for "Rate" and "Pay" are filled in by the Accounting Department.

The completed time card is approved by the worker's supervisor to verify that the work recorded has really been done.

Now, on a separate sheet of paper, draw a time card like the one shown on Page 4. Develop it for your production project and corporation. You can issue these to the foreman to use with students on the production line.



TIME RECORD — Week Ending..

Name..

Thu.	Fri.	Sat.	Sun.	Mon.	Tue.	Wed.	Total	Work Item	Project	Oper.	Job	Appro.	Amt.
								Continue additional items on reverse side of card.					

Total Time..............................**Rate**..........................**Pay**..............................**Approved**..............................

5M-1-69 W.P.S.

FOR THE STUDENT   No. E-59

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

USING A SCHEDULE BOARD

Objective:

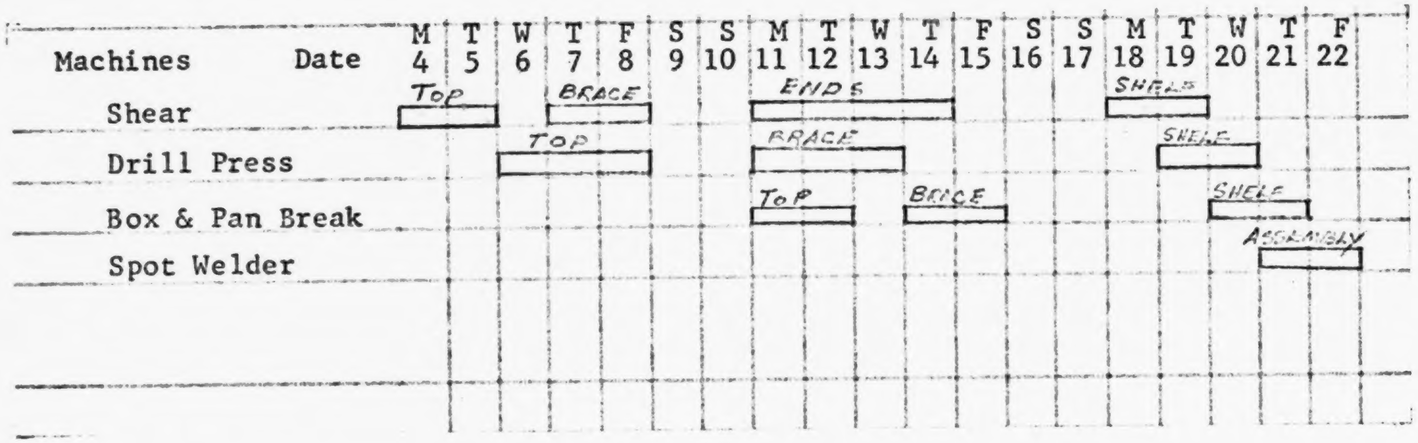
Given information pertaining to machines available and route sheets for parts to be produced, you will make a schedule board showing when the parts will be processed by each machine.

Activity:

Scheduling involves an understanding of and a respect for the element of time. Work must be started on each component, allowing sufficient time to perform each operation needed so that it will arrive at the proper place ready to be mated with other parts to form the finished article. Some of the factors to be considered when scheduling are: (1) output capacity of available machines; (2) transportation time; (3) process time; (4) storage facilities, and (5) shipping date for the order. Quantities must also be considered in light of economy of production, past sales records, and forecast of future sales.

In order to graphically represent conditions pertaining to work load and progress, several types of visual control boards have been developed. One popular form is the Gantt Load and Progress Chart, originated by Henry L. Gantt, a Management Engineer of the early 1900's era. It shows work volume and time. Along the left margin of the chart are listed various operations and the machines that perform each operation. Horizontally across the top is a time scale, usually covering a two-week period. Time can be broken down by day, shift, hour, or further if so desired. Variations of this basic idea are commercially produced and sold under other trade names. Any of these devices can be a valuable aid in scheduling operations, but they are only valid to the extent that the information is kept current.

In your Laboratory, make a schedule board for use with your class production project. Draw a chart like the one shown on Page 2, listing the machines in your laboratory along the left side of the page. Across the top of the chart list the dates of the days that your class meets or whatever element of time seems best suited to your class project. Using the route sheets (produced from Package E-63) for the parts to your class project, work out a schedule that will permit the parts to be produced with the most efficient use of time and machines.



EACH DAY COLOR IN BAR FOR WORK THAT HAS ACTUALLY BEEN DONE. CHART WILL THEN INDICATE CURRENT STATUS OF ALL PARTS.

FOR THE STUDENT No. E-61

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

TESTING ASSEMBLED PRODUCTS

Objective:

Given a situation with an assembly line producing a product, you will inspect the finished units to see that they meet the standards set up by the designers and make a decision, based on this inspection, as to whether the units may be packaged or must be repaired.

Activity:

Obtain a random sampling of the finished units being produced by your class production line. Carefully check the item to see that it performs as it was intended. Measure the item; compare all dimensions to those given on the blueprint. Inspect the overall appearance of the product, being sure it looks satisfactory and is ready to be delivered to the customer.

It is important that you choose samples that are representative of all the units being manufactured, not just the good ones. If no defects are found, send the inspected parts, along with the others, to the packaging department.

If any units are found to be defective, inspect all units produced and send all defective units to an area set aside for modification or repair. These units should each be inspected after repair and only those free of defects allowed to go on to packaging. Refer to Package E-62 for directions on Analyzing Production Problems.

Post Test:

Suppose that your class is producing lamps. You are the inspector. You are checking 2 lamps out of every 6 lamps produced. You have 10 lamps to check, which means that 30 lamps have been produced. The first 3 lamps that you inspect work fine and are passed. You inspect 2 more lamps and discover that neither of them will light. Answer the following questions about the above situation:

1. What will you do with the 3 good lamps?

2. What will you do with the 2 defective lamps?

3. What will you do with the other 25 lamps that have been produced?

FOR THE STUDENT No. E-62

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

ANALYZING PRODUCTION PROBLEMS

Objective:

Given an assembly line producing a product which inspection has determined to be defective, you will initiate action that will cause whatever change is required to correct the defect.

Activity:

Prepare a detailed description of the nature of the defect. Determine all the possible causes for the defect by discussing the problem with representatives of the Engineering Department and the Production Department.

If the cause of the defect proves to be a weakness in the design, then the Engineering Department must modify the design and make the necessary changes in the drawings or the materials specified.

If, on the other hand, the cause is associated with the production line, it then becomes the responsibility of the Production Department to make the necessary adjustments.

The main point here is that inspection should be followed up by some action to correct the cause of the trouble.

Post Test:

Suppose you are the inspector who has located a number of items that all have the same defect. What two departments should you contact about this condition?

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

DEVELOPING A ROUTE SHEET

Objective:

Given information about one part of your product, develop a route sheet showing the operations to be performed, the work stations where they will be done, and the order in which they must be done.

Activity:

1. Look at a working drawing of the part to be manufactured. Using small cards, write down all the operations that must be performed to make the part. Put each operation on a separate card.
2. Lay the cards out on a table so that you can see all the operations. Arrange them in a line, starting with the first thing that needs to be done, then the next, and so on until you have all the operations arranged in their proper order. Be sure to include at least one inspection in the operations.
3. Number the cards so that you can put them in the right order if they should get mixed up.
4. Look at each card and determine where that operation will be done. Write the name or number of that work station on the card.
5. On a separate sheet of paper, make a chart like the one shown on the next page. Fill in the information from the cards you have prepared.
6. Make route sheets for all the parts in your production project.
7. Give the completed sheets to your Foreman for use by the Manufacturing Division.

ROUTE SHEET

Name of Part ______________ Number to be Made ______________

Operation	Work Station	Remarks
1. Shear 3" x 9"	Squaring shear - bench	Material - .032 Alum., T-6
2. Drill 7 holes 1/4"	Drill press	
3. Fold	Box & Pan Brake	
4. Inspect	Bench #4	
5. Paint	Finishing Room	#317 Yellow - 2 coats

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

TRANSFER FROM FULL SCALE TO ¼" SCALE

OBJECTIVE: Given a piece of paper with a series of five horizontal lines two inches apart, a pencil and a standard architects scale, or 12" ruler, you will convert from full scale (length in inches) to the one quarter scale. 1"=1" to ¼"=1" In order to complete this package you must be able to do four of the five problems correctly.

PRETEST: CONVERT full scale to one fourth scale. Circle the correct answer.

1. How many inches when using the ¼" scale, does a five inch line equal?
   A. 10 B. 20 C. 30 D. 40
2. How many inches when using the ¼" scale does a two and one half inch line equal?
   A. 10 B. 20 C. 30 D. 40
3. How many inches when using the ¼" scale does a three and one fourth inch line equal?
   A. 9 B . 11 C. 13 D. 15

When you have completed the pretest check with your instructor.

ACTIVITY:

1. Measure each of the five lines on the next sheet with your scale or ruler and record these in the space provided marked FULL SCALE.
2. Scaling is a method used to convert large measurements to smaller ones . A good example of scaling is in the making of maps. The whole world can be drawn on a small piece of paper. One inch in that case could equal as much as one thousand miles.
3. The plans for a house can be drawn to scale on a piece of paper that is easy to handle as compared to drawing it full scale.

On the next page you will convert (scale down) the full scale measurements into ¼"=1" scale. This is done by multiplying the

3. Continued.

full scale length by four.

4. To convert (scale down) to the one eight inch equals an inch all you do is multiply the full scale measurement by 8.

5. Note: There is an example of the work sheet which was handed out with this package.

FULL SCALE__________

1.............. ________________________________ ¼" SCALE__________

FULL SCALE__________

2...... ____ ¼" SCALE__________

FULL SCALE________

3.... ____ ¼" SCALE________

FULL SCALE________

4............. ______________ ¼" SCALE________

FULL SCALE________

5.... __________________________________ ¼" SCALE________

EXAMPLE: A LINE TEN INCHES LONG (FULL SCALE) WOULD EQUAL A LINE FOURTY INCHES LONG (¼" SCALE). MULTIPLY THE LENGTH IN INCHES(FULL SCALE) BY FOUR.

X$ 10" x 4=40

FOR THE STUDENT

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

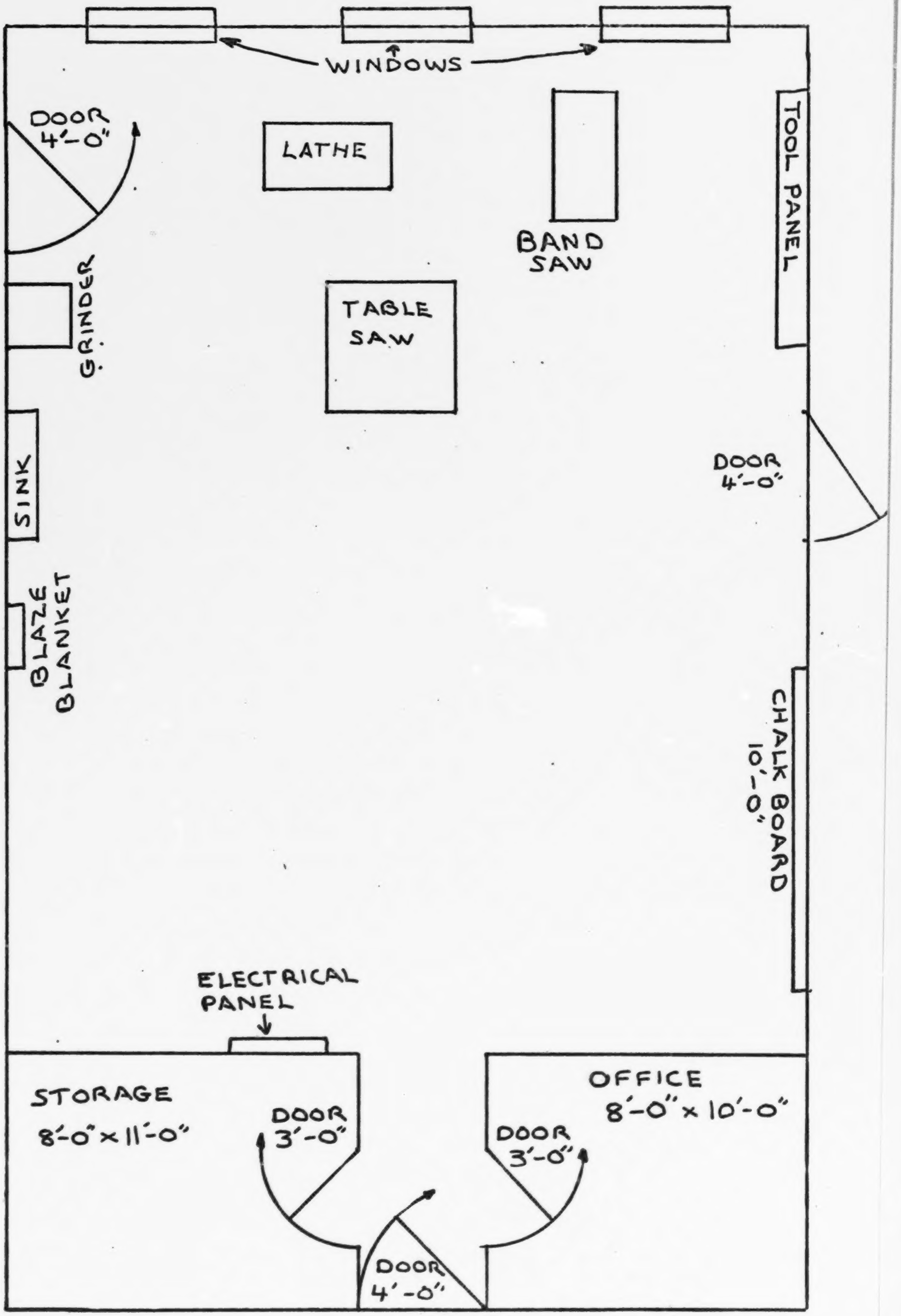
FLOOR PLAN OF A PRODUCTION AREA

OBJECTIVE: Given ¼" graph paper, and a tape measure, you will lay out the floor plan for your lab. Using the scale ¼" = 1', (one quarter inch equals one foot,) you will locate all fixed equipment and furniture. This includes doors, windows, sink, machines and lockers.

PREREQUISITE: Package E-100.

ACTIVITIES:

1. In package E-100 you converted full scale to the ¼" scale. In this package you will do a very similar operation. Only this time you will be using graph paper to actually lay out the size and shape of your lab. See sample which is attached.
2. Measure and record the size and shape of your lab.
3. Once the size and shape of the lab floor is drawn on the graph paper, show the location of the windows, doors, sink, and safety equipment.
4. Color coding may be used on the basic layout to indicate the different areas; Windows-blue, doors-green, sink-yellow, and safety equipment-red.
5. Proceed now to locate the fixed machines and equipment. Fixed machines and equipment are those which are bolted to the floor or are too heavy to move.


WINDOWS
DOOR 4'-0"
LATHE
BAND SAW
TOOL PANEL
GRINDER
TABLE SAW
SINK
DOOR 4'-0"
BLAZE BLANKET
CHALK BOARD 10'-0"
ELECTRICAL PANEL
STORAGE 8'-0" x 11'-0"
DOOR 3'-0"
OFFICE 8'-0" x 10'-0"
DOOR 3'-0"
DOOR 4'-0"

FOR THE STUDENT

E-102

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

MOVABLE FURNITURE AND MACHINE TEMPLATES

OBJECTIVE: Given a pair of scissors , some colored construction paper, a pencil, and a ruler, you will make a template (see note below) for each piece of movable equipment in the lab, using the scale ¼"=1'.

NOTE: A template is a pattern which represents an object. In this case your templates will represent such items as a workbench, or table saw, or some other piece of movable equipment in your lab.

PREREQUISITE: E-100, E-101.

ACTIVITIES:

1. Lay out on the construction paper (scale ¼"=1') the shape of each piece of movable equipment in your lab.
2. Lable each template by name.
3. Cut out template accurately.
4. Show the complete set of templates to your instructor for his approval and place them in an envelope.

FOR THE STUDENT E-103

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

LAYOUT OF A FLOW CHART

OBJECTIVE: Given the floor plan of your lab, (E-101), the templates for movable machines and equipment (E-102), the production route sheet (E-63), and some rubber cement, you will arrange the templates of the movable furniture and equipment on the floor plan to produce the best material flow pattern for production.

ACTIVITY:

1. Place the floor plan sheet and templates on a clean flat, dry, surface.
2. Review Package E-63.
3. Arrange with two or three other interested students to sit in on a brainstorming session. One suggestion would be to place all templates on the floor plan sheet (E-101), and each student in turn would suggest an arrangement or partial arrangement to improve the layout.
4. Once a decision has been made as to the best layout the instructor should be consulted before the templates are cemented down. (See note below)
5. Cement the templates in place.
6. When you have completed your task arrange for a meeting with all the people involved in the Planning For Production And Manufacturing Operations.

NOTE: Do not be afraid to try more than one position for the templates before you cement them to the floor plan.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

LAYOUT OF A MASTER FLOOR PLAN

OBJECTIVE: Given a piece of 1/4" graph paper, a tape measure, you will layout the actual floor plan for your lab. Using the scale of 1/4" equals 1 foot, you will locate all fixed equipment and furniture. This master floor plan will be used to confirm the layout performed by your students in package E-101.

Activity:

1. Measure and record on a rough sketch, the size and shape of the lab floor.
2. Transfer the dimensions to the piece of 1/4" graph paper.
3. Locate all doors, windows and fixed equipment on the graph paper.
4. You may want to use some sort of color code as this will give quick identity to the various parts of the layout.
5. Make up a completed sample using a different floor-plan and attach it to E-101. This will be a guide for the student to refer to before he begins work on the requirements for E-101.

SUGGESTED ACTIVITIES:

1. A simple slide series showing various types of floor plans used in different industrial installations.
2. Use of an overhead projector with a piece of graphed acetate showing how to make a rough sketch and record dimensions. This would relate directly to Activity #1 on E-101.

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

SUGGESTED ACTIVITIES

OBJECTIVE: You will organize a field trip or special demonstration related to plant safety.

Suggested Activities:

1. Contact local chapter of the American Red Cross. They will be very cooperative in helping you organize and present a basic first aid demonstration.
2. During the annual Fire Prevention Week your local Fire Department will put on a live demonstration, at the school, pertaining to causes of fires as well as fire extinguishment.
3. Local industry is always eager to assist schools in planning tours as well as interviews with special personnel. A tour might be arranged with a local industrial firm and a meeting with their Safety Engineer.
4. Insurance companies have men trained just to accomodate schools and special groups interested in certain areas. The Insurance Company of North America, The Mutual of Omaha,The Prudental Company and The Travelers Insurance Company are just a few who do this sort of work. They have done extensive research in the general area of Industrial Accident Prevention.
5. Consult the Guide to Free Films located in the Public Library. There is a listed number of films on Industrial Safety produced by General Motors, General Electric, Stanley Tool Company, and several others

FOR THE STUDENT E-111

PLANNING FOR PRODUCTION AND MANUFACTURING PROCESSES

DETERMINING SAFETY STANDARDS FOR MANUFACTURING

OBJECTIVE: Given a list of materials and processes to be used in the production of a product (D-12,13)with the basic layout of the production area (E-101), you will determine whether basic safety standards are being met, and prepare a written report for your instructor.

ACTIVITIES:

1. Basic safety standards include; fire regulations, lighting requirements, ventilation in general as well as in special areas, non-skid areas around machines and dangerous work areas, electrial requirements such as fuses and circuit breakers, enough electrical outlets, plug caps installed correctly, location of fire extinguishers near dangerous operations such as welding operations.
2. Refer to check list on next page.
3. Contact your local Office of Industrial Safety, and ask them for the copy of "Industrial Safety Standards" they use when they inspect new buildings or building changes. The office may be located within the department of Public Safety or Industrial Commission.
4. After you have examined the basic layout and inspected the lab using the check list and information offered by the local office, you will complet a Safety Standard report for your lab and submit it to the instructor.

LAB SAFETY CHECK LIST

DIRECTIONS: Read each question and circle the correct answer.

1. Is there a fire extinguisher and blaze blanket located close to an area where flamable materials are being used? YES NO

2. Does the lab have a fire alarm box or button? YES NO

3. Does the lab have a sprinkler system? YES NO

4. Are all flamable liquids properly stored in fire proof cabinets or other suitable containers? YES NO

5. Is the lighting good in all areas of the lab? YES NO

6. Does each machine have a special light which spots the work area? YES NO
(An example of the light asked about in #6 would be the special light usually found on drillpresses, grinders, etc.)

7. Is the lab vented? YES NO

8. Is there special ventilation for the areas which produce most of the smoke, such as the foundary and welding areas? YES NO

9. Is there a special non-skid area around each machine? YES NO

10. Is there an electrical panel which contains all the switches and circuit breakers for the entire lab? YES NO

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

TYPES OF FIRES AND FIREFIGHTING EQUIPMENT COMMON TO INDUSTRY

OBJECTIVE: Given a list of common types of fires, the information needed to determine which extinguisher to use on the different types of fires, you will complete the list on the next page.

ACTIVITIES:

1. The following is a list of the common fires found in industry: Dust Fires (sawdust, paper dust, etc.), Grease fires, cloth fires, liquid fires (gas, oil), metal fires, paint and varnish fires, plastic fires, rubber fires, and chemical fires.

2. You have learned in Science that there are three basic types of matter, solids, liquids, and gases. Generally it must be said that there are three types of general fires each with its own reaction to fire extinguishers and fire extinguishment materials.

3. All fires need oxygen in order to burn. To put out a fire you must stop the flow of oxygen as well as the supply of fuel.

4. Fires which are burning in solids (wood), may be extinguished with water. Another type of extinguisher which may be used for that type of fire is the soda-acid or foam extinguisher.

5. Liquids, by their nature, are much different than solids and must be handled differently. The best example of this would be an oil fire. If water is used the oil will only float on the water and thus spread. Dry chemical or CO_2 type extinguishers may be used on liquid fires.

6. Gases, again by their nature, must be handled differently. The best method of stopping a gas fire (natural gas), is to cut off the supply of the gas. Also the heavy foam type of extinguisher may be used.

7. On the following sheet is a list of several materials which will burn. In the space provided you are to to write the name of the type of fire extinguisher or the name of the material which can be used to put out that fire. If more than one is usable list all.

8. If you get stuck on any of the types you may want to call the local Fire Department for the information. Remember they are the experts!

9. Submit your completed list for approval by your instructor.

ACTIVITY SHEET

NAME______________________________DATE__________

WOOD______________________________

RUBBER TIRES______________________________

YARN AND CLOTH______________________________

GREASE______________________________

GASOLINE______________________________

MAGNISIUM (METAL)______________________________

VARNISH______________________________

FIBERGLASS______________________________

SAWDUST______________________________

WAX______________________________

CANVAS______________________________

KEROSENE______________________________

TARPAPER______________________________

OIL BASE PAINT______________________________

PLEXIGLASS______________________________

TRUCK TIRES______________________________

PROPANE______________________________

GRAIN DUST______________________________

LATEX PAINT______________________________

ELECTRIC MOTOR______________________________

PLANNING FOR PRODUCTION AND MANUFACTURING OPERATIONS

WHERE TO LOCATE A FACTORY

OBJECTIVE: Given the general criteria for the choice of a location, and a list of three types of factories, you will write a report on the choice of location of any two factories listed.

Activities;

1. There are several important factors which must be considered prior to the construction of a new building. They are:
   - A. Availability of raw material. This is one of the most important factors in the proper selection of a site.
   - B. Market for the product of the factory. If the product is food, for example, the factory must be located near good transportation facilities.
   - C. Labor. The factory will need workers which are suited and trained for that particular type of production.
   - D. Utilities must be available. Gas, water, and electricity. Certain factories need more water. For example the paper industry needs more water than the shoe industry.
   - E. Waste disposal. This includes, smoke, solids and liquids. If the city or town does not have a way to dispose of industrial waste, the factory must spend the money to build some sort of waste treatment area. This added cost might be saved if the factory would locate where all of this is available.
   - F. Geography. The cost of the land, the cost to prepare the land for construction, and tax relief are all major considerations.
2. An example of a good choice of location would be a fish packing plant located near one of the several fishing ports along the coast, The raw material is available, transportation is available, the needed labor force is also available, as well as the necessary utilities, water, electricity,etc. .

3. An example of a poor location choice would be a fish packing plant located in the Mohave Desert. The raw material is not available, the transportation problem is much greater, the needed labor force is almost non-existent and the great amount of water needed for the processes is not available.

4. You are now going to be incharge of selecting a site for a new factory. You have been given some facts about the selection of a site, now listed below are three suggestions. Choose two of the three and write a complete report on why you picked the location you did.

5. The three factories for you to pick from are;
   - A. Steel mill.
   - B. Textile mill.
   - C. Atomic Bomb factory. (special safety needed)

6. The report should be about one page in length for each factory location. Be sure to include all the important facts as to why you chose the site you did.

7. Your local school library or public library may be helpful in helping you determine certain geographical facts. Also, do not be afraid to speak with your social studies teacher.

8. Go.

FOR THE STUDENT

No. F-1

PRODUCTION OR MANUFACTURING

THE STUDENTS WILL SELECT A PRODUCTION SUPERVISOR

Objective:

You will select, among yourselves, a production line supervisor.

Activity:

1. All production workers should form together as a group.
2. One student should serve as temporary chairman of the group.
3. The chairman will now call the group to order, and read the duties and functions of the production supervisor. See next page.
4. The chairman will now open the floor for nominations for the position of production supervisor.
5. The students will nominate several members of the group for the position.
6. One student will move that the nominations be closed.
7. Another student will second that the nominations be closed.
8. The chairman will now write the names of the candidates for production line supervisor on the board.
9. The students will vote on the candidate of their choice by writing his name on a piece of paper and placing it in a container.
10. The chairman will count the votes and announce the winner.

DUTIES AND FUNCTION OF THE PRODUCTION SUPERVISOR

No. F-1

1. Training: The supervisor must know how to prepare the best training sequence to teach an employee how to do a job.

2. The handling of grievances: The supervisor must examine the causes of grievances and determine whether they are caused by work climate, wrong job placement, inadequate job training, or for personal reasons.

3. Worker rating: The supervisor must rate each student-worker, and give the grade to the instructor.

4. Managing the budget: The supervisor must keep records of material cost, and manpower cost.

5. Timekeeper: The supervisor must tell the group when to clean up and how much time is allotted to different jobs.

6. Recorder: The supervisor must report absent or tardy persons to the teacher each day.

FOR THE TEACHER

No. F-2

PRODUCTION OR MANUFACTURING

DUTIES AND RESPONSIBILITIES OF THE SHOP FOREMAN

Objective:

The student will list 5 major duties and responsibilities of a shop foreman.

Activity:

I. Discuss with the students the following things expected of the foreman by the workers in his department:

1. That the foreman knows his job.
2. Courteous and consistent treatment.
3. Necessary tools, materials and instructions to do a good job.
4. Fair play - no favoritism.
5. Fair wages.
6. Opportunity to talk things over freely.
7. Understanding the employee's problems.

II. Discuss immediate duties and responsibilities which call for leadership by a foreman.

1. Maintaining quality standards.
2. Getting out the days work on time.
3. Improving work methods.
4. Keeping costs down.
5. Dealing with personnel problems.

Post test:

List 5 major duties and responsibilities of the foreman.

1. ____

2. ____

3. ____

4. ____

5. ____

FOR THE STUDENT

PRODUCTION OR MANUFACTURING

THE STUDENTS WILL SELECT A PRODUCTION SAFETY ENGINEER

Objective:

You will select, among yourselves, a safety engineer.

Activity:

1. All production workers should form together as a group.
2. One student should serve as temporary chairman of the group.
3. The chairman will now call the group to order, and read the duties and functions of the safety engineer. See next page.
4. The chairman will now open the floor for nominations for the production safety engineer.
5. The student will nominate several members of the group for the position.
6. One student will move that the nominations be closed.
7. Another student will second that the nominations be closed.
8. The chairman will now write the names of the candidates for production safety engineer on the board.
9. The students will vote on the candidate of their choice by writing his name on a piece of paper and placing it in a container.
10. The chairman will count the votes and announce the winner.

DUTIES AND FUNCTION OF THE PRODUCTION SAFETY ENGINEER

1. The safety engineer must check the entire plant and look for items that may cause accidents.

2. The safety engineer observes work habits of members of the group. He warns persons who do not follow good safety practices, and reports to the production supervisor if safety rules are not followed.

3. The safety engineer should keep equipment in good working order.

4. The safety engineer must see to it that when a report of an unsafe piece of equipment is turned in, maintenance and repair is done immediately.

5. The safety engineer must see to it that sufficient number of containers for waste materials are located in the work area.

6. The safety engineer should check the floor for grease, water, improperly stacked or misplaced materials, and loose objects on floor, stairs, and platforms.

FOR THE STUDENT

No. F-4

PRODUCTION OR MANUFACTURING

SELECTING A SHOP STEWARD

Objective:

Given a sheet containing information about unions and the selection of a shop steward, the students will select one student to function as a shop steward.

Activity:

Answer the following questions:

1. What is meant by AFL?

____

2. What is meant by UAW?

____

3. List one main duty of a shop steward.

____

4. If you cannot answer questions 1, 2 and 3, go to question # 6.
5. If you can answer questions 1, 2 and 3, check with the teacher or the foreman. If your answers are correct go to # 9. If wrong, go to number 6, 7 and 8.
6. AFL is a labor union - the American Federation of Labor.
7. The UAW is the United Auto Workers union representing workers in automobile plants.
8. The shop steward represents the workers of the plant in regards to grievances, working conditions, or union membership.
9. Select a shop steward.

THE SHOP STEWARD

1. What is a shop steward?

   The shop steward is the person who represents the workers of a plant. He is also a typical worker in the plant.

2. What are the shop steward's functions?

   He communicates with the employer, as well as the union business representatives on matters such as working conditions in the plant and worker treatment.

3. He checks new employees for union membership and makes sure that all workers are in good standing and that dues are paid. Occasionally he may collect dues and issue identification.

4. How is a shop steward selected?

   He is selected by the members of the workers subject to the acceptance of Union officials depending on which is the bargaining organization for the workers of a plant or factory.

FOR THE TEACHER

NO. F 5

PRODUCTION OR MANUFACTURING

THE STUDENT WILL FILL OUT JOB APPLICATIONS

OBJECTIVE:

As a result of this lesson the student will learn:

1. What a job application looks like.
2. The basic techniques in filling out a job application.

ACTIVITY:

1. Have students pick up job application blank from the personnel director.
2.. After student have secured their applications from the personnel director, have them sit in a class room setting.
3. Fill out the application along with the students and give them what ever assistance is necessary in helping them complete the application.

④

EMPLOYMENT
APPLICATION
(SALARIED)

1702 .

VICKERS Division
OF SPERRY RAND CORPORATION

PLOYMENT ACT OF 1967 PROHIBITS
DISCRIMINATION ON THE BASIS OF
AGE WITH RESPECT TO INDIVIDUALS
WHO ARE AT LEAST 40 BUT LESS
THAN 65 YEARS OF AGE."

F 5

DATE	FIRST CHOICE OF POSITION WANTED	SECOND CHOICE	APPROXIMATE SALARY EXPECTED PER MONTH $

NAME (FIRST) (MIDDLE) (LAST) — SOCIAL SECURITY NO.
PLEASE PRINT

ET ADDRESS (CITY) (ZONE) (STATE) — TELEPHONE NO.

AGE	DATE OF BIRTH (MO.) (DAY) (YEAR)	CITIZEN OF U.S. YES ☐ NO ☐	HEIGHT	WEIGHT
~~COLOR OF~~ ~~HAIR~~ ~~EYES~~	SINGLE ☐ MARRIED ☐ WIDOWED ☐ SEPARATED ☐ DIVORCED ☐ OWN HOME ☐ BUYING ☐ RENTING ☐ BOARDING ☐		NO. DEPENDENT CHILDREN	OTHER DEPENDANTS

~~HAVE YOU EVER WORKED UNDER ANY OTHER NAME THAN STATED ABOVE YES ☐ NO ☐ WHEN REASON~~

ANY PHYSICAL DISABILITIES WHICH SHOULD BE CONSIDERED IN YOUR PLACEMENT

FORMER EMPLOYEE OF VICKERS YES ☐ NO ☐	PREVIOUS APPLICATION MADE YES ☐ NO ☐	IF YES, WHAT PLANT	~~DO YOU OWN A CAR~~ ~~YES ☐ NO ☐~~

INDICATE WHETHER YOU WILL:
TRAVEL ☐ YES ☐ NO RELOCATE ☐ NO ☐ YES — EARLIEST DATE AVAILABLE

FATHERS NAME	PLACE OF EMPLOYMENT	OCCUPATION
HUSBANDS NAME WIFES	PLACE OF EMPLOYMENT	OCCUPATION

LIST NAMES AND AGES OF CHILDREN (THIS IS FOR INSURANCE DETERMINATION)

NOTIFY IN ERGENCY NAME
ADDRESS
RESIDENCE PHONE
BUSINESS PHONE

~~RELATIVES EMPLOYED BY VICKERS NAME RELATIONSHIP DEPARTMENT~~

HAVE YOU EVER BEEN CONVICTED OF A CRIME
IF YES, GIVE DATE, PLACE, CHARGE AND DISPOSITION

HAVE YOU EVER BEEN DENIED A SECURITY CLEARANCE YES ☐ NO ☐ WHAT TYPE FOR WHAT REASON

SKILLS

INDICATE WORK SKILLS IN WHICH YOU ARE MOST PROFICIENT, SUCH AS TYPING, SHORTHAND, DESIGN, ENGINEERING
DENOTE THE NUMBER OF YEARS EXPERIENCE IN EACH

MILITARY SERVICE

HAVE YOU SERVED IN U.S. ARMED FORCES YES ☐ NO ☐	BRANCH	DATE OF ENTRY	DATE AND TYPE OF SEPARATION

RATE OR RANK AT TIME OF SEPARATION	MILITARY OCCUPATION OR SPECIALTY
ARE YOU RECEIVING SERVICE DISABILITY PAYMENTS ES ☐ NO ☐	EXTENT OF DISABILITY

PRESENT DRAFT CLASSIFICATION	LOCAL BOARD NO.	REGISTRATION NO.
ARE YOU A MEMBER OF RESERVES OR NATIONAL GUARDS YES ☐ NO ☐ UNIT	ACTIVE	INACTIVE

EDUCATION

	NAME OF SCHOOL	LOCATION	YR ENTERED	YR LEFT	DEGREE OR CERT	MAJOR COURSE
ELEMENTARY						
HIGH SCHOOL					GRADUATE YES ☐ NO ☐	
COLLEGE OR UNIVERSITY						
GRADUATE SCHOOL						
OTHER						

EXTRA CURRICULAR ACTIVITIES AND HONORS

UNDERGRADUATE

MAJOR MINOR

GRADUATE

MAJOR MINOR

TITLE OF THESIS

TITLE AND REFERENCE TO PUBLICATIONS

OTHER RESEARCH AND SPECIAL STUDIES

SPECIALIZED FIELDS AND PROBLEMS ON WHICH YOU WOULD LIKE TO WORK

PROFESSIONAL ACTIVITIES AND SOCIETY MEMBERSHIP

PRESENT OR LAST EMPLOYER

MAY WE CONTACT YOUR PRESENT EMPLOYER YES ☐ NO ☐

NAME OF COMPANY	TYPE OF BUSINESS AND NUMBER OF EMPLOYEES	TELEPHONE NO.

ADDRESS (STREET) (CITY) (ZONE) (STATE)

TITLE OF POSITION	NAME OF SUPERVISOR

DESCRIPTION OF WORK

DATE HIRED (MONTH) (YEAR)	DATE LEFT (MONTH) (YEAR)	SALARY START__________ PER______ SEPARATION__________

REASON FOR CONSIDERING CHANGE

PREVIOUS EMPLOYERS (BEGIN WITH ONE PRECEDING YOUR LAST OR PRESENT POSITION)

NAME OF COMPANY	TYPE OF BUSINESS AND NUMBER OF EMPLOYEES	TELEPHONE NO.

ADDRESS (STREET) (CITY) (ZONE) (STATE)

TITLE OF POSITION	NAME OF SUPERVISOR

DESCRIPTION OF WORK

DATE HIRED (MONTH) (YEAR)	DATE LEFT (MONTH) (YEAR)	SALARY START________ SEPARATION________ PER________

REASON FOR LEAVING

NAME OF COMPANY	TYPE OF BUSINESS AND NUMBER OF EMPLOYEES	TELEPHONE NO.

ADDRESS (STREET) (CITY) (ZONE) (STATE)

TITLE OF POSITION	NAME OF SUPERVISOR

DESCRIPTION OF WORK

DATE HIRED (MONTH) (YEAR)	DATE LEFT (MONTH) (YEAR)	SALARY START________ SEPARATION________ PER________

REASON FOR LEAVING

NAME OF COMPANY	TYPE OF BUSINESS AND NUMBER OF EMPLOYEES	TELEPHONE NO.

ADDRESS (STREET) (CITY) (ZONE) (STATE)

TITLE OF POSITION	NAME OF SUPERVISOR

DESCRIPTION OF WORK

DATE HIRED (MONTH) (YEAR)	DATE LEFT (MONTH) (YEAR)	SALARY START________ SEPARATION________ PER________

REASON FOR LEAVING

REFERENCES

WHO REFERRED YOU TO OUR ORGANIZATION ____________

NAMES OF FRIENDS WITH THIS COMPANY ____________ DEPT. ____________

LIST BELOW THREE REFERENCES OTHER THAN RELATIVES OR FORMER EMPLOYERS WHO HAVE KNOWN YOU FOR AT LEAST TWO YEARS.

NAME	ADDRESS	PHONE	OCCUPATION

ADDITIONAL INFORMATION

I DECLARE MY ANSWERS TO THE QUESTIONS ON THIS APPLICATION ARE TRUE, AND GIVE VICKERS INCORPORATED THE RIGHT TO INVESTIGATE ALL REFERENCES GIVEN AND SECURE ADDITIONAL INFORMATION IF NECESSARY. I HEREBY RELEASE FROM ALL LIABILITY OR RESPONSIBILITY ALL PERSONS, COMPANIES, OR CORPORATIONS FURNISHING SUCH INFORMATION. I SUBMIT THIS APPLICATION WITH THE UNDERSTANDING THAT A PHYSICAL EXAMINATION SATISFACTORY TO THIS COMPANY MUST BE PASSED BEFORE EMPLOYMENT CAN BE EFFECTED. AGREE TO FURNISH A CERTIFIED COPY OF BIRTH RECORD OR NATURALIZATION PAPERS AS WELL AS FEDERAL SOCIAL SECURITY ACCOUNT CARD. I ALSO AGREE TO PERMIT THE COMPANY TO TAKE FINGERPRINTS OF MYSELF, WHICH ARE TO BE AND REMAIN THE ABSOLUTE PROPERTY OF THE COMPANY WHETHER THIS APPLICATION IS GRANTED OR NOT. I UNDERSTAND THE USE OF THIS FORM DOES NOT INDICATE THERE ARE ANY POSITIONS OPEN AND DOES NOT IN ANY WAY OBLIGATE THIS COMPANY. I UNDERSTAND THAT FALSIFICATION OF INFORMATION ON THIS APPLICATION MAY RESULT IN MY DISCHARGE.

SIGNATURE OF APPLICANT ____________ DATE ____________

INITIAL INTERVIEW BY	DATE	SECOND INTERVIEW BY	DATE
INTERVIEWERS COMMENTS		INTERVIEWERS COMMENTS	

EMPLOYMENT HIRING AUTHORIZATION

DATE ACCEPTED ____________ DATE TO START ____________ PROCESSED BY ____________

DIVISION ____________ DEPARTMENT ____________ LOCATION ____________ EXT. ____________

DEPT. NO. ____________ BLDG. ____________ SHIFT ____________ REQ. NO. ____________ JOB CLASSIFICATION TITLE ____________ JOB CLASS NO. ____________

SALARY PER MO. $ ____________

PAYROLL ☐ RESTRICTED ☐ UNLIMITED ☐ PRIVATE

IF REHIRED COMPLETE THE FOLLOWING FROM SALARY ☐ FROM HOURLY ☐

☐ SB ☐ SCC

SUPERVISOR OR DEPT. HEAD ____________ OTHER APPROVAL ____________

PRINTED U.S.A

PRODUCTION OR MANUFACTURING

ESTABLISHING A TRAINING PROGRAM

Objective:

Given a product in production, and a man at each step in the production line, the foreman will:

1. Determine at what point in the production line training is needed.
2. Establish a training program to meet these needs.

Activity:

1. The foreman will get the list of processes or jobs that are necessary to complete the product. (This list can be obtained from Planning for Production and Manufacturing - Package #E 63)
2. The foreman willlist the skills necessary to perform each process. (See Page 2)
3. The foreman will now have each student perform the required operations, to see if the students have the necessary skills to perform the job.
4. The foreman will now determine what training is required for each student to perform his specified operation.

No. F-7

AN EXAMPLE OF HOW THE ACTIVITY SHOULD BE DONE

JOB: Producing printed circuit boards for a product.

NAME OF PROCESS	SKILL REQUIRED	TRAINING REQUIRED	WHERE TRAINING WILL BE OBTAINED
Cut blank of copper clad board to exact size for selected circuit.	1. Use of ruler 2. Use of cutting equipment	1. Use of the cutting tool.	1. The foreman (or a package)
Using carbon paper and a hard pencil (4H) transfer circuit design to the copper-clay. Mark holes to be drilled for all components.	1. Use of hands 2. Ability to transfer the circuit design	1. Use of (4H) pencil to transfer a design	1. The foreman (or a package)
Drill #40 Pilot holes for all components. Enlarge holes by gradually increasing drill size until proper size is reached.	1. Use of drill	1. Drill Press	1. Drill foreman (or a package)
Carefully paint the transferred pattern with acid-resistant paint and allow to dry.	1. Ability to paint.	1. Painting	1. The foreman (or a package)
Etch in bath of ($FeCl_3$) for one to two hours. Remove from bath, wash with clear water and remove resistant paint with cloth and solvent.	1. None	1. None	
Holes for wires may now be drilled using a #54 drill.	1. Use of drill	1. Drill Press	1. Drill foreman (or a package)
Mount parts and solder, avoid excess heat, but have no rosin joints.	1. Soldering	1. Soldering	The teacher or foreman (or a package)

FOR THE STUDENT

No. F-8

PRODUCTION OR MANUFACTURING

THE FOREMAN WILL INTERVIEW JOB APPLICANTS

Objectives:

Given a set of applications for jobs on the production line, the foreman will select a student for each job according to interests, talents, skills, and physical qualities.

Prerequisite:

Package F-7

Activity:

1. The foreman will pick up the job applications from the personnel director.

2. The foreman will then review the applications and separate them according to the jobs requested.

3. The foreman will send out notices to students, and ask them to come in for an interview.

4. When the student comes in for an interview, the foreman should get the following information:

   a. The student's personal interests.
   b. The student's talent, as described by the student.
   c. The student's skills as they relate to the job the student wants.
   d. The student's physical ability to do the job applied for.

5. After the students have come in for an interview the foreman will then select and send out notices for job acceptance, and job rejection.

FOR THE STUDENT

PRODUCTION OR MANUFACTURING

PLACEMENT OF WORKERS ON A PRODUCTION LINE

Objective:

Given a list of processes required in the production of a product, and a list of students qualified to perform the various manufacturing processes, you will prepare a list assigning the necessary personnel to the production line.

Activity:

1. Obtain student package number E-64 from Planning for Production.
2. Refer to package number F-5 of Production or Manufacturing and select students qualified to perform the required activity at the production stations.
3. Prepare a production assignment sheet. See sample sheet on page 3 of this package.
4. Present this assignment sheet to the production supervisor or your teacher for verification and acceptance.
5. Refer to: Suggestions for Assigning Workers.

SUGGESTIONS FOR ASSIGNING WORKERS

No. F-8

A. Review the assignment sheet to make sure that only qualified students have been placed. If job calls for drilling on a drill press, student assigned should have the skills necessary.

B. Rotate the workers on the production line. This will depend on the nature and complexity of the product. Rotation might be on a daily basis. Each process should involve as many students as possible.

C. There is the possibility that a surplus of workers will occur. These could become "extras" and be employed as relief workers to take over a position in "emergencies".

Production Assignments (sample)

Production of: Pencil holder

Starting Date ____________________

Worker	Job	Station No.
A	Mold Preparation	1
B	Casting	2
C	Remove Casting	3
D	Transfer Casting to process station 5	4
E	Drilling Operation	5

PRODUCTION OR MANUFACTURING

PRODUCTION OR MANUFACTURING SYSTEMS

Objective:

Given a classroom discussion on the three different types of methods used to produce goods, the student will be able to list all three types and give a minimum of 2 examples of goods produced by each method.

Activity:

Attention needs to be given to the types of production or manufacturing systems that are employed to process materials and produce or manufacture goods.

Discussion:

The production or manufacturing system used depends upon the nature of the product, the processes employed in making the product, and the quantity of production. If only a few or even one of a kind is to be produced, the situation would be classified as custom production. Special cars, homes and experimental research equipment are generally made by a custom manufacturer.

The intermittent manufacturing method is used when the number of units is substantial - 30 or more. In this case, a system is employed whereby the number of ordered products or parts can be produced in the shortest possible time at lowest possible cost. Most goods are produced by this system of production. (i.e. watch bands, antennas, batteries).

If the demand for a product or part is great, a system of mass production is used (i.e. manufacturing pencils, pens, etc.). Sometimes the plant is automated. Goods are produced with a minimum of workers, automatically and continuously, without interruption. In some cases, re-tooling is not required for several years because the consumer is purchasing the product without demanding change. (i.e. paper plate).

Post test:

List three types of methods used to produce goods. Following each method, list at least 2 products produced by that method.

FOR THE STUDENT No. F-10

PRODUCTION OR MANUFACTURING

SAFETY INSPECTION

Objective:

You will prepare a safety check list to be used to determine the safeness of the lab subsequent to production.

Activity:

1. Prepare a listing of the things that each student of the lab should comply with or follow to be considered a safe worker. (See next page)

2. Prepare a second list for safety of operation of lab equipment and machines. (See next page)

3. Prepare a third list of machine structures that should be a part of these machines to be considered safe. (See next page)

4. Present your lists to the teacher or Supervisor.

STUDENT REFERENCE FOR PACKAGE NO. F-10

Examples for List #1. Things each student should comply with or follow to be SAFE. Only two are given, but you will be able to list more.

1. Wear eye protection.
2. Avoid startling a worker by keeping voices at a low level.
3.

Examples for List #2. Safe operation of lab equipment and machines.

1. Only the operator, trainee or authorized workers should operate equipment.

2. Limit the operation to the capacity of the machine.

Examples for List #3. This safety pertains to the machine itself.

1. Guards around gears.

2. Easy access to the power switches so the machine can be quickly shut off if necessary.

THE STUDENT WILL SELECT THE METHOD OF TRAINING NEEDED IN THE PRODUCTION OF A PRODUCT

Objective:

Given a process in production, the materials being processed, and the experiences of performing this operation, you will list the physical and cognitive skill required to perform that operation.

Activity:

1. Obtain the materials being processed from the storage room.
2. Place the material at that point in the production line where the process is being studied.
3. Have five students perform that particular process.
4. Have five other students list the body movement, the way the material was placed in that process and all skills necessary in performing that process.
5. Report the results of your analysis to your teacher.

FOR THE STUDENT No. F-12

PRODUCTION OR MANUFACTURING

TRAINING THE PRODUCTION LINE WORKER

Objective:

Given the job of training a production line worker, you will prepare a list of instructions, in writing, and then work with another student until he is able to successfully take over for you on the production line.

Activity:

1. List, on a sheet of paper, the instructions you received and then followed to do your job on the production line. (See sample on next page).
2. Take your list to the foreman or teacher for checking and approval.
3. Ask the foreman to provide you with a student who is to take over your job.
4. Briefly, explain to your trainee what he is expected to do.
5. Go through the processes of your job in the production line at least twice and have the trainee watch you do the assigned work.
6. Tell the trainee to take over your job while you watch him work.
7. Continue watching your trainee until you think he has received enough training and experience to be able to work alone.
8. Leave the area where your trainee is working so that he can't see you watch him. Don't "sneak" a look to see how he's doing.
9. Report the training of your student to the foreman.
10. Return to your trainee after several minutes and check to see how he's doing. Ask him whether he needs any more help.
11. If he can do the job to your satisfaction, report this to the foreman so that he may verify your instruction of the student and give you your next assignment.

Student Reference Sheet For Package No. F-12

A SAMPLE

Trainee's Name____

Your Name____

Job Description:
Face both ends of 4"x ½" steel rods on the lathe.

---

1. Place rod in chuck.
2. Face one end of rod.
3. Remove rod.
4. Mark rod for length - 4 inches.
5. Place rod in chuck - unfaced end out.
6. Face second end of rod.
7. Remove rod and check for correct length - 4 inches.
8. If correct, place rod as directed by production planning.

Foreman signature_______________________________

FOR THE STUDENT

No. F-13

PRODUCTION OR MANUFACTURING

DETERMINING HANDLING AND TRANSFER TIME

Objective:

Given a stop watch and the route sheet of the product developed in package No. E-63 you will determine the total time required to transfer materials.

Activity:

1. Obtain package No. E-63 from Planning for Production and Manufacturing Operations.
2. Select another student to work with you.
3. Prepare a table similar to the sample on next page.
4. Using the stop watch, determine the time it took to transfer the material for the part from the supply room to the station for operation #1. Record.
5. Continue your timing from one operation to the next until the part has reached it's final destination.
6. Calculate the total handling or transfer time required for the production of one part.
7. Calculate the total transfer or handling time required for all the produced parts.
8. Present your results to the supervisor or teacher.

REFERENCE SHEET FOR STUDENT PACKAGE NO. F-13

Name of part______________ Number to be made__________

Transfers	Minutes	Seconds
Supply to Operation 1		
Operation 1 to Operation 2		
Operation 2 to Operation 3		
Operation 3 to Operation 4		
Operation 4 to Operation 5		
Operation 5 to Storage		
Total time (for 1 part)		

Total time (for production of all parts)__________

FOR THE STUDENT

NO. F14

PRODUCTION OR MANUFACTURING

TROUBLESHOOTING AND PERFORMING MINOR ELECTRICAL REPAIRS.

OBJECTIVE:

When the electrical system breaks down, you will perform minor repairs as needed.

ACTIVITY:

1. NOTE: The check list that follows does not specify all problems that occur in a system, but does list many of the common problems.
2. PROBLEM: Circuit breaker or switch keeps cutting off.

   CHECK LIST

   A. Check all wire connections and make sure they are not shorted to ground.

   B. Too many operations working off the same line, change some of of the electrical operations to another inlet line.
3. PROBLEM: Electric motor running hot.

   CHECK LIST

   A. Extension cord leading to the motor is too small in diameter.

   B. The extension cord leading to the motor is too long, causing a considerable drop in current.
4. PROBLEM: Electrical motro will not run when turned on. Upon giving it a manual turn with the hand, however, it began to run.

   CHECK LIST

   A. The starting winding in the motor is burned out. Have it rewound or replaced with another motor.

5. PROBLEM: When the motor is connected into the electrical system nothing happens.

CHECK LIST

- A. Go to the master switch and flip all switches off and on.
- B. Check cord leading to socket for any cuts or disconnections in cord.
- C. Go to the storage room and get a check lamp and test the socket for current. If there is no current:
  1. Check all other operations on the same line and see if they are working.
  2. If all others are operating, chances are you have a bad socket. Turn off the master switch and replace socket, (Check with your teacher before doing this).

FOR THE STUDENT No. F-15

PRODUCTION OR MANUFACTURING

DETERMINING WASTE IN PRODUCTION

Objective:

Given a balance scale and a piece of raw material - wood, metal, or plastic - you will process the material as specified for production, and then determine the percentage of waste resulting from processing the material.

Pre-requisite Skills:

Before attempting this activity, you must be able to:

1. Use the balance scale.
2. Determine weight using the metric system.
3. Add, subtract, multiply and divide numbers.
4. Change decimal numbers to percent.

Activity:

Refer to the sample on page 2 before proceeding to step #1.

1. Select a piece of raw material - wood, metal or plastic.
2. Weigh the piece of material on the scale. Record the weight to the nearest gram.
3. Cut, sand, grind or remove by whatever method specified, so that the piece will be altered as required.
4. Weigh the piece again. Record its weight to the nearest gram.
5. Divide the weight you obtained in step #4 by the weight obtained in step #2.
6. Convert your answer of step #5 to percent.
7. Subtract the percentage of step #6 from 100%. This is the percent of waste resulting from processing the original piece of raw material.
8. Compute the quantity of waste resulting if you produced 100 pieces exactly like the one you made in step #3. Convert your answer to pounds.
9. Show your results to your teacher.

STUDENT REFERENCE SHEET FOR PACKAGE NO. F-15

A SAMPLE

The weight of a 1" x 3" x 10" piece of wood is 150 grams. It was cut in half. The combined weight of the two pieces is now 140 grams.

WASTE: 150 grams - 140 grams = ____10____ grams.

TO FIND THE PERCENT OF WASTE:

Division: 140 grams ÷ 150 grams = ____.93____

Convert to percent: .93 = 93%

Percent of Waste: 100% - 93% = ____.07%____

TO FIND AMOUNT OF WASTE IN 100 PIECES:

Multiply: 100 x 10 grams = ____1000____ grams.

TEACHER REFERENCE SHEET FOR PACKAGE NO. F-15

It is suggested that the balance scale required for this package and the instruction on its use, be obtained from the school's science department.

FOR THE STUDENT

NO. F 16

PRODUCTION OR MANUFACTURING

TAKING INVENTORY

OBJECTIVE:

After all products have been produced and distributed to the consumers, you will take inventory of all remaining storage room supplies.

ACTIVITY:

1. Definition of Inventory:
   Inventory is a well organized record of all property or material owned by an organization or company.

2. Purpose of inventory:
   The main purpose of inventory is to insure that there are enough supplies on hand and available for use; and to insure that not too much material is on hand at any one time.

3. Go to your teacher or supervisor and get a check list of all supplies that were on hand before the product was produced (Developed in package No. F. 23).
4. Go to the storage room and check off all materials that you have on hand, using the form on the next sheet.
5. Give the completed list to your supervisor or teacher.

INVENTORY SHEET

LOCATION OF ITEM	ITEM NAME	QUANTITY
Middle shelf, storage	Capacitors	50-.05 UUF
In middle shelf, storage area	Resistors	25-100 Ohms Resistors
EXAMPLE	EXAMPLE	EXAMPLE

FOR THE STUDENT

NO. F 17

PRODUCTION OR MANUFACTURING

ORDERING SUPPLIES FROM STORES

OBJECTIVE:

When the supplies in the storage room are running low, you will prepare a requisition for more supplies, and give it to your purchasing agent.

PREREQUISITE:

1. Packages E-40 and 41.

ACTIVITY:

1. While your product is being produced, check the storage room often to see whether supplies are running low.
2. Write the name of supplies on a sheet of paper.
3. Go to your teacher and obtain a requisition form.
4. Fill out the requisition and place all the materials you need on it.
5. Give the requisition to the purchasing agent.

REQUISITION

QUANTITY	LISTED NUMBER	DESCRIPTION
60	22459	100 Ohms resistors with 10% tolerence 1/2 Watt
25	6421	.005 **Capacitors**

PRODUCTION OR MANUFACTURING

RECEIVE AND STORE SUPPLIES

Objective:

Given a shipment of supplies and a shipping list, you will compare the kind and quantity of items received with those on the list and put them in the proper place in the storeroom.

Activity:

1. See your foreman and have him assign another student to work with you.

2. If the supplies are in boxes, take them to an area in the lab where you will have a minimum chance of being disturbed or losing items as a result of getting them mixed up with other lab materials.

3. Open the boxes carefully and in such a manner that you will not damage any of the contents. DO NOT REMOVE ANY ITEMS YET!

4. Remove the shipping list. One of the boxes will contain this list if it is not taped to the top of one of the boxes. See sheet #3 for a sample shipping list.

5. Check the list for the quantity of boxes or distinct separate items shipped.

   Number of boxes or separate items listed ______

6. Count the number of boxes or separate items received.

   Number received. ________.

7. Have your assistant remove one item at a time from the boxes. DO NOT DISCARD ANY PACKING MATERIAL OR BOXES AT THIS TIME.

8. Find the item on the shipping list. If more than one, have your assistant count them. Check off the items received. If there is a shortage or overage, make a notation on the shipping list.

9. Repeat steps #7 and #8 until the boxes are empty and you have checked off all the items listed by the shipper.

10. Take the shipping list to your teacher for approval.

11. After approval, take all received supplies and put them in their proper places in the storeroom

12. Very carefully check through the boxes again. When you are satisfied that only shipping boxes and packing materials are left, take them to the proper place for discarding.

13. Report to your foreman for another assignment.

REFERENCE SHEET FOR STUDENT PACKAGE NO. F-18

SAMPLE SHIPPING LIST

CUSTOMER COPY

VENDOR Hardware Sales
ADDRESS 16th EYe St. Florence, Nev.

Official use only

CUSTOMER Kennedy Union High School
ADDRESS Little Bighorn, Wyo.

SHIP BY IHA Trucking No. cartons 2

Cat. No.	Quan.	Description	Ship	*X	unit cost	total cost
A61	25	Lock sets	10	15		
2318	100	Hinges	100			
J1	1 ea	30 x 48" ST Alum.	1			
950	10	Safety glasses	10			
WH20	2 gal	Resin glue	1	0		

30 DAYS Net C.O.D._______

* This quantity is back-ordered. If 0 entry, item is no longer stocked.

NOTE TO THE STUDENT: Shipper has entered 2 cartons shipped. One of these could be the count for the sheet of aluminum.

FOR THE STUDENT No. F-19

PRODUCTION OR MANUFACTURING

MAINTAINING STORES RECORDS

Objective:

Given the job of tending the storeroom, you will issue materials when properly requisitioned and keep a record of everything that you issued and to whom you made the issue.

Activity:

You have been assigned the job of issuing materials. This is a responsible position because production workers will greatly depend on getting the materials they will need to do their work. You will be expected to issue their requirements without delay.

1. Familiarize yourself thoroughly with the contents of the storeroom. Especially, know where all materials are located, in the storeroom, that will be needed in the production or manufacture of the parts or products in progress so that you will be able to issue material quickly.

2. Do not allow other, unassigned, students in the storeroom. They might get in your way and reduce your efficiency.

3. Issue only those materials that are requested on the accepted REQUISITION FORM. MAKE SURE the requisition was authorized by the proper authority - signed by him.

4. As you issue material, make a list and at the end of the class period subtract these quantities from the master storeroom list. See sample on next sheet.

5. If the count of any item, on the master list, is below the minimum quantity listed, notify your teacher

6. Staple all requisitions together so that they will be available for future reference if needed.

REFERENCE SHEET FOR STUDENT PACKAGE NO. F-19

SAMPLE MASTER STOREROOM LIST

MASTER STOREROOM LIST

DIRECTIONS: Use only PENCIL to make changes or notations. Subtract the quantity issued from the quantity on hand, then erase the previous quantity and enter the remaining quantity.

ITEM (NAME)	Min. Quan.	Quan. On Hand	Quan. (ORDER)
Solder (rosin core)	2 lbs.	8	
Resistors (10,5W)	10	2	8
2N255 (trans)	2	0	2

FOR THE STUDENT

NO. F 20

PRODUCTION OR MANUFACTURING

PROVIDING SUPPLIES ON THE PRODUCTION LINE.

OBJECTIVE:

After production has begun you will route the material on the production line and keep each station supplied with all necessary materials.

PREREQUISITE:

You should be well equipped with the materials that are being used to produce a particular product, and know where these materials belong.

ACTIVITY:

1. Every day before the production line is set up, go to the storage room and obtain all the materials for each station.
2. Take these materials to their station.
3. Place these materials in the place provided for them.
4. When the production line is running, check each station frequently to see if materials need to be removed, or if more materials are needed.
5. When the production line closes down (F-31) you will take all materials from each station back to the storage place.

FOR THE STUDENT

No. F-21

PRODUCTION OR MANUFACTURING

PREPARING A PROCESS PROGRESS RECORD

Objective:

Given the route sheet developed by Planning for Production and Manufacturing, you will check and make a record of the progress being made in meeting the production schedule established for your product and submit a written report to the planning department.

Activity:

Often, the Planning for Production and Manufacturing department would like to know how the production of a part or product is progressing. Unexpected difficulties may have occurred which weren't anticipated when the release, to produce something, was given. Our department will be expected to be alert to problems as they arise and report back to planning so that a solution can be found and the necessary changes made.

1. Obtain package No. E-63, for your product, from Planning for Production and Manufacturing.
2. Request your foreman to accompany you to all the work stations indicated on the route sheet.
3. From the workers, at each station, inquire whether he is having any difficulty with the material he is processing or the method of processing used. If he is having difficulties, make a notation on paper.
4. Check and record the number to be made as requested on the route sheet. Also, record the number already produced.
5. Briefly, summarize the facts obtained in steps 3 and 4. Write the summary on a sheet of binder paper.
6. Arrange a brief session with the supervisor and your foreman. Go over your summary. If it is acceptable to them, take it to the planning department.

FOR THE STUDENT No. F-22

PRODUCTION OR MANUFACTURING

QUALITY CONTROL

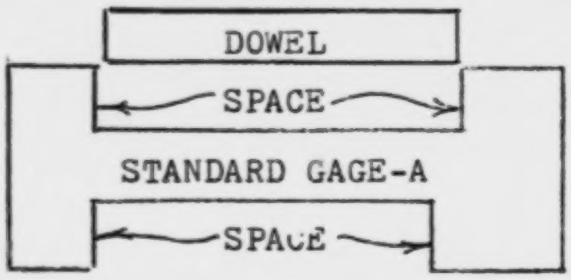
Objective:

Given a minimal acceptable tolerance of a part, twelve production-made pieces, and a measuring standard, you will determine whether the production-made pieces meet the minimal standards established by the design engineer.

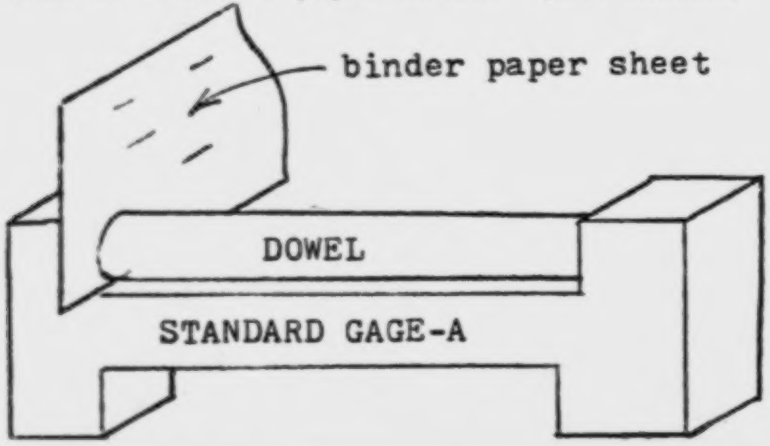
Activity:

Instructions: Do steps 1 through 10.

1. Go the the A-V library and select slide and tape set #F-22. View the slides and listen to the tape.
2. Go to the box marked: Quality Control-size tolerances.
3. Remove the 12 wooden dowels and the standard gage-A.
4. Compare each dowel with the 2 spaces of the measuring gage. (See sketch)

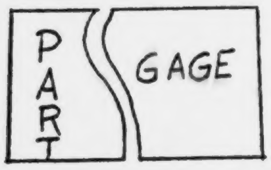


5. Place all the dowels that are longer than the longest space on one pile and label it - too long.
6. Place all the dowels that are shorter than the shortest space on a second pile and label it - too short.
7. Compare the dowels you have left with the long space again, but this time, as you place each dowel in the long space, add 1 thickness of a binder paper sheet. (See sketch)



8. Place all the dowels that do not fit in the long space when you added the thickness of the paper on the pile labeled - too long.
9. Place the dowels you have left in a third pile and label - "within tolerance".
10. Take the dowels in the third pile and the measuring standard to the foreman or instructor for checking.

TEACHER'S REFERENCE SHEET FOR STUDENT PACKAGE

Slides	Narration
1. Title Slide: Quality Control	Music.
2. Scene: Mass Production	Mass production methods are the outstanding manufacturing achievements of this century. Pause
3. Scene: Batch or lot of mass produced parts	Here you see parts of a product that were produced in large numbers. All of these parts have been produced with all dimensions within specified limits and will fit in any one of the final machines or products. Pause
4. Scene: Size and shape tolerances	Do you know what is meant by tolerance? A tolerance is a limit of variation permitted from the exact actual size or shape of a part. Pause
5. Scene: Comparator-Instructor made gage.	How could you quickly check a part for size tolerance? Pause A very quick way is to make a comparator gage. The gage is constructed of durable material with the allowable sizes against which you can compare the parts. Pause
6. Scene: Commerical gages - blocks, etc.	Here you see some standard gages used for tolerance measurement.
7. Scene: Shape tolerances. 	It is often necessary to check a part for correct shape: is it square, is the angle correct, is it round enough. This can be done by making a pattern against which to check the shape of the part.

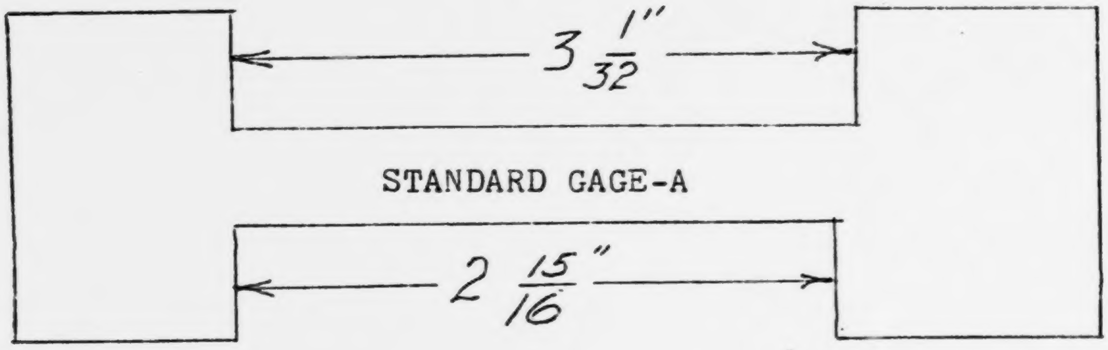
Slides (continued)	Narration (continued)
8. Scene: Dowels described and made.	Now follow steps 2-10 on your work sheet to check the tolerances for the sample production-made pieces.
9. Slide: End	Music.

TEACHER'S REFERENCE SHEET FOR STUDENT PACKAGE No. F-22

1. Cut twelve ½" wooden dowels (iron rod may be used) to the following length:

   2 ea 3-1/8" long.
   1 ea 3" long.
   8 ea 3-1/32" long.
   1 ea. 2-7/8" long.

2. Construct a comparator (measuring gage without dimensions). Use durable material at least ¼" thick with spaces as indicated by the following drawing:



FOR THE STUDENT

NO. F 23

PRODUCTION OR MANUFACTURING

A CHECK LIST OF PRODUCTION MATERIALS

OBJECTIVE:

The student will make a check list of all materials on hand before production.

ACTIVITY:

The student will fill out the check list on the next page.

CHECK LIST OF MATERIALS BEFORE PRODUCTION		
Location of Item	Name of Item	Quantity
Top shelf storage room	Resistors	50-100 Ohms. Resistors. 20-100 Ohms. Resistors
EXAMPLE	EXAMPLE	EXAMPLE

FOR THE STUDENT No. F-24

PRODUCTION OR MANUFACTURING

PARTS AND PRODUCT INSPECTION

Objective:

Given the quality acceptance standards of a part or the finished product, you will make the inspection rejecting those not meeting the specification of the engineering department.

Pre-requisite

You must have completed package No. F-22 before you attempt this package.

Activity:

1. Obtain the inspection schedule for the product from the engineering department.
2. Go to the station where inspections are to be done.
3. Remove one inspected part or assembly from each inspection station.
4. Inspect these parts again to see whether they, in fact, meet the requirements set forth by quality control.
5. Mark the inspection sheet accordingly as you determine the quality or tolerances. You have only to decide whether to reject or accept after re-inspection.
6. Write a brief inspection report and present this to the production engineer.

STUDENT REFERENCE SHEET FOR PACKAGE NO. F-24

Sample inspection sheet.

Product: Canasta Tray

Part	Reject	Accept
End #1		✓
End #2		✓
Base		✓
Top		✓
Finish Sanding		✓
Stain		✓
Spray finish	✓	

FOR THE STUDENT No. F-25

PRODUCTION OR MANUFACTURING

DEVELOPING A CHECK-OFF SHEET

Objective:

Given a completed part or a completely assembled product, you will examine it and prepare a check-off sheet listing the items that must be checked before the product is to be released.

Activity:

1. Obtain a completely processed part or a completely assembled product and examine it.
2. Make a list, on scratch paper, of those items which you feel should be considered and checked off before the part or product is to be released for distribution.
3. Take your list and the part or product to at least 5 other students and obtain their opinions.
4. Scratch off any items on which the majority disagree and add items they feel should be included.
5. Present your check-off list to your teacher for approval.
6. If approved, transfer the check-off items onto a 3 x 5 card. If disapproved, make the necessary changes and submit again until approved.
7. Reproduce enough cards so that one card is to accompany each single part or product. List only items of the check-off list approved by the teacher. See sample check-off card on next page,

STUDENT REFERENCE SHEET FOR PACKAGE NO. F-25

SAMPLE CHECK-OFF CARD

The following is a check-off list for a metal tool box.

FINAL METAL TOOL BOX CHECK-OFF LIST

MODEL 70

1. Paint and Wiped ✓
2. Drawers Required ✓
3. Drawer Spacing ✓
4. Drawer Movement & Burrs ✓
5. Drawer Locking ✓
6. Stainless Steel Trim ✓
7. All Hardware Included ✓

*8. Lock & Keys. ✓

*NOTE: LOCK MUST BE CHECKED WITH KEYS REMOVED IN LOCKED AND UNLOCKED POSITION.

INSPECTOR I. Ness

FOR THE STUDENT

NO. F 26

PRODUCTION OR MANUFACTURING

PERFORMING PREVENTIVE MAINTENANCE ON ELECTRICAL SYSTEMS.

OBJECTIVE:

Given an inspection checklist, you will perform all necessary inspections and preventive maintenance.

PREREQUISITE:

The student who performs preventive maintenance on electrical systems should have had a basic course in electricity.

ACTIVITY:

1. You should keep a good inventory of spare parts, such as fuses, switches, extension cords, sockets, connectors, and offer spare components.
2. Use the inspection checklist on page two of this package to inspect your electrical system.
3. Perform a day-by-day visual check to see whether sparks are coming from any part of the electrical system.
4. Make sure that workers operating electrical motors keep a continuous visual check of their particular motor to see whether it smokes. If it does, the operation should be terminated immediately.

INSPECTION CHECK LIST

1. Check all extension cords that are being used on electrical parts and see if they are overheating. This may be done by simply, grasping the cord in your hand. If the cord is excessively hot, exchange the cord for one with a heavier gauge wire.

2. Check to see if the extension cord has a ground connector. If it does, make sure it is connected. If it does not, connect an adaptor to the end of the cord before attaching it to the system.

3. Check all switches and make sure no bad connections exist.

4. Make sure there are not too many operations running on the same line at the same time.

5. Make sure all extension cords used on electrical motors are not too long. If they are too long the voltage drop in the line will be too great, and the motor will heat up.

FOR THE PRODUCTION STUDENT

NO. F27

PRODUCTION OR MANUFACTURING

PERFORMING PREVENTIVE MAINTENANCE ON FLUID POWER SYSTEMS.

OBJECTIVE:

Given an inspection checklist, you will perform all necessary inspections and preventive maintenances.

PREREQUISITE:

1. The student who performs preventive maintenance on fluid power systems should have had a course in basic fluid power.

ACTIVITY:

1. You should keep a good inventory of spare parts, such as seals, bearings, extra hydraulic fluid, filters, and other spare components.
2. Use the inspection check list on page three of this package. This check list identifies points and items to be checked on fluid power machinery, and when checks should be made.
3. Perform day-by-day duties, such as changing fluid or filters, and checking the level of oil in the reservoirs.
4. Check the reservoir daily for any materials that will damage the components of the system.

5. Check the oil to make sure it is not over-heating.

6. Check each pump to see if it is cavitating.

INSPECTION CHECK LIST

1. Check the reservoir to see if any harmful particles are in the oil.

SUCH AS:

- A. Rags
- B. Metal chips
- C. Pieces of wood and,etc.

2. Check to see if pumps or valves are taking in air.

3. Check the oil level in the reservoir and see if it is about 3/4 full.

4. Check the oil temperature and see if it is between 130 and 160 degrees.

FOR THE PRODUCTION STUDENT

NO. F28

PRODUCTION OR MANUFACTURING

TROUBLESHOOTING AND PERFORMING MINOR FLUID POWER SYSTEM REPAIRS.

OBJECTIVE:

When the fluid power system breaks down, you will perform minor repairs as needed.

ACTIVITY:

1. NOTE: The check list that follows does not specify all problems that occur in a system, but does list many of the more common ones.

2. PROBLEM: Lack of full pressure in the system

Check List

A. Air in the system.

B. Pump starved by clogged inlet strainer

C. Loose inlet connections to pump.

D. Defective seals on cylinder piston assembly or rod gland.

E. Check valve not seated.

F. Defective or worn pump.

G. Defective or worn fluid motor.

H. Scorn motor valve plate or pump plate.

I. Incorrect hydraulic fluid.

3. PROBLEM - No pressure in system

Check List

A. Pump turning in wrong direction.

B. Fluid in reservoir two low.

C. No resistance in the system.

D. Air breather clogged in the reservoir.

E. Pump inlet blocked.

4. Problem - Activating cylinder fails to develop full speed.

Check List

A. Air in system.

B. Wrong viscosity fluid.

C. Relief valve defective or set too low.

D. Defective seals in cylinder piston assembly.

E. Defective fluid motor.

F. Fluid too hot and thin, causing excessive internal leakage.

G. Inlet to pump blocked or too small.

5. PROBLEM - Erratic motion of cylinder.

Check List

A. Air in system.

B. Defective seals in cylinder piston assembly or fluid motor.

C. Air breather in reservoir blocked.

D. Pump inlet leaks.

E. Defective pump.

F. A defective check valve.

G. Broken spring in a control valve.

6. PROBLEM - Fluid in system over heating.

A. Conductors too small for the fluid being delivered.

B. Wrong grade of fluid or dirty fluid.

C. Not enough in the system.

D. Relief valve held open by dirt.

E. Cooling system inadequate.

7. PROBLEM - Air in system.

A. Defective seals.

B. Leaks at joints.

C. Too little fluid in system.

D. Pump inlet too long.

E. Improper maintenance procedures.

FOR THE STUDENT

PRODUCTION OR MANUFACTURING

PREVENTATIVE MAINTENANCE-LUBRICATION

Objective:

Given a card file consisting of the preventative maintenance schedules for the lab equipment, you will perform the tasks to be done on the day of your assignment.

Activity:

1. Go to the preventative maintenance card file.
2. Remove all the cards on which preventative maintenance jobs are to be done today.
3. Perform the preventative maintenance called for on the cards.
4. Show the teacher the cards, which you removed, for inspection.
5. Return the cards to the proper place in the card file.

TEACHER REFERENCE SHEET FOR STUDENT PACKAGE F-30

1. Prepare a student assignment sheet for preventative maintenance. (See Sample)

PREVENTATIVE MAINTENANCE ASSIGNMENTS

NAME	DATE(S)
Jim Tiel	Feb. 16 - Feb. 18
George Aide	Feb. 19 - Feb. 20

2. Prepare 3x5 cards, one for each piece of equipment. Front side lists preventative specified the manufacturer. Back of card for response that gives date and student's signature that activity was performed. (See Sample)

FRONT OF CARD

__________ DATE   ______________________ NAME OF MACHINE

Oil Machine every __________ days.

CHECK: Level of grease in gear box.
Level of cutting oil in reservoir.

CHANGE: Oil every __________ Months __ Weeks __

______________ Kind of oil   __________ Weight of oil

Grease in gear box every __________ months

______________ Kind of grease   __________ Weight of grease

CLEAN: Cutting oil sump every __________ days.
Oil filter every __________ months.

OTHER: ______________________________

BACK OF CARD

DATE	NAME	DATE	NAME

3. Arrange the cards in a card file according to the week and month when preventative maintenance is to be done.

FOR THE STUDENT

NO. F 31

PRODUCTION OR MANUFACTURING

CLOSING DOWN THE PRODUCTION LINE

OBJECTIVE:

At the end of each production day you will close down the production line by putting all materials and tools in their assigned place, within fifteen minutes.

ACTIVITY:

1. At the end of each production run, the production foreman will stop all production.

2. Carry your tools and check them in at the tool room.

3. Return to your work station and clear all materials from your work station.

4. Carry those materials in process to your storage area.

5. Take a brush, broom or any other cleaning tool and brush or dust your area.

6. The students who are responsible for routing materials on the production line should now take a broom and sweep the floor.
7. All students should then return to their seats.
8. The supervisor dismisses the class, when the shop is clean and all materials are put away.

FOR THE STUDENT

NO. F 33

PRODUCTION OR MANUFACTURING

TRANSFERING COMPLETED PRODUCTS TO STORAGE

OBJECTIVE:

Your product will be inspected by your instructor or a student inspector. After the inspection, you, as the production group, will transfer the product to storage.

ACTIVITY:

1. Get the chart for recording deficiencies noted during inspection, (see package F-23).
2. Inspect each detail of your product. Refer those with deficiences back to production or service for repair.
3. If you find no deficiencies, transfer, (by whatever means available) your product to storage. (see package 34)

FOR THE STUDENT No. F-34

PRODUCTION OR MANUFACTURING

PREPARATION FOR START-UP

Objective:

Given the assignment of checking the production equipment for proper operation, you will check all the machines and report readiness to the foreman.

Activity:

1. Check all major production equipment for production readiness.
2. Check all jigs and fixtures. Make sure they are installed properly and safely.
3. List machines or equipment that, in your opinion, are not safe or ready to be used for production. Do this on a note pad.
4. Cycle all power equipment in the lab. Do this by running the machine, at operational speed and performing the specified operation on a piece of scrap material.
5. Report your findings to the foreman or the teacher.

FOR THE TEACHER No. F-34

PRODUCTION OR MANUFACTURING

INSPECTION METHODS FOR DEFECTS

Objective:

Given 7 inspection methods, the students will be able to list at least 5 and identify those listed as being destructive or nondestructive.

Activity:

Discussion:

Various inspection methods can be used for detecting defects in parts produced in the manufacturing or production process. These methods are classified as destructive or nondestructive. Destructive tests include the sawing or breaking of selected parts at places where defects are suspected. Since saw cuts and breaks may easily miss internal flaws, these tests are not dependable.

PROCESS INSPECTION. Inspections or tests made while parts are being produced are to detect defects and allow corrections to be made before all parts have been processed, i.e., before it is too late.

VISUAL INSPECTION. The simplest, fastest, and most commonly employed method for finding many defects is visual. Practically all parts are subjected to some visual inspection but this is limited to those defects which can be observed on surfaces.

DIMENSIONAL INSPECTION. This involves the use of measuring instruments such as micrometers, vernier height gages, and others to verify the specified dimensions of a part. Refer to package No. F-22 - Maintaining Quality Control.

PRESSURE TESTING. Products to be used for containing or conveying liquids or gases may be tested for leaks through their walls by introducing a gas or liquid under the specified pressures. Submerging the container under water for gas leaks or by visual inspection for liquid leaks is a practical method used to make pressure tests.

RADIOGRAPHY. Special equipment, generating radio type waves invisible to the eye, is used to determine flaws in castings. The ability of these invisible rays to penetrate depends upon wavelength and the density of the material. The workpiece is exposed, where defects are suspected, to a uniform beam of these rays emitted from a suitable source. Behind the workpiece, perpendicular to the rays and as close as possible, is placed a photographic film in a lightproof cover called a "cassette". During exposure, rays penetrate more easily along paths where there is less metal, thus a shadow picture is produced on the film, showing relative thicknesses of the metal as seen in the direction of ray travel.

Two types of radiography energy sources are generally used: x-ray - for easily accessable situations and Gamma-ray - for use in places where it is impossible to use x-rays.

MAGNETIC PARTICLE TESTING. This method supplements testing by radiography. For example, radiography ordinarily cannot detect small cracks, especially those so small that they cannot be seen with the human eye. In a magnetized piece of ferrous metal, if a crack or void interrupts a magnetic field, the magnetic field will be distorted.

A common method used is to place the part in a magnetic field. After magnetizing, fine particles of a magnetic material, such as iron, are applied over the surface to be inspected. Some of this powder will be attracted to and held by magnetic flux lines which extend out into the air over voids and cracks. Thus small cracks and voids at or slightly below the surface can be detected.

PENETRANT TESTING. This is also a method for detecting small surface cracks similar to those detected by magnetic particle testing. It has an added advantage because it can be used for any material. Basically, penetrant testing makes use of a liquid with an excellent wetting and penetrating ability. When applied, this liquid is readily drawn into extremely small surface openings by capillary action. The penetrating liquid contains either a material which fluoresce under ultraviolet light, a dye, or some other means for later detecting it. After being dipped or sprayed, the part surfaces are carefully cleaned, the excess penetrant removed and dried. A powder material called a "developer" may then be applied to the surface. This powder draws the penetrant back out of the cracks by capillary attraction and it can be more readily seen.

ULTRASONIC TESTING. Three testing methods employing high-frequency sound waves: reflection, through transmission, and resonant frequency. The ultrasonic sound is produced by a quartz crystal. Changes of voltage, impressed upon it, cause corresponding changes in the thickness of the crystal so that by impressing a high-frequency alternating current (1,000,000 Hz) across the faces of the crystal, ultrasonic sound is produced. The crystal is held against a smooth surface of a metal workpiece and the sound waves are transmitted to and travel through the metal. The time interval between transmission of the outgoing and reception of the incoming signals are measured with a cathode-ray oscilloscope. Flaws within the material will reflect some of the sound, and will return it earlier to the instrument. This method for locating flaws within metal parts is more sensitive than radiography.

Post-test:

List 5 inspection methods commonly used in manufacturing. Label each method as being destructive or or nondestructive.

1. ______________________________ ________________

2. ______________________________ ________________

3. ______________________________ ________________

4. ______________________________ ________________

5. ______________________________ ________________

FOR THE STUDENT No. F-35

PRODUCTION OR MANUFACTURING

DETERMINING MAN-HOUR WASTE

Objective:

Given a stop watch, you will identify the idle workers, determine the amount of time they were not producing and prepare a report to be submitted to the supervisor.

Activity:

1. Select a partner to work with you.
2. Observe the laboratory during a manufacturing session.
3. How many students were idle when you made the survey? Ans. ______________
4. Ask your partner to start and stop the stop-watch when you tell him to do so.
5. Select a production worker, and each time he wastes time or has nothing to do, start the watch. Stop the watch each time he resumes work. Continue this procedure for 15 minutes.

   How much time was idle? Minutes idle: ___________
6. Repeat step #5 with another student.

   Minutes idle: ______________
7. Repeat step #5 with a 3rd student.

   Minutes idle: ______________
8. Find the total idle time by adding the minutes in steps 5, 6, and 7.

   Ans. ________________
9. Present your findings to the supervisor.

FOR THE STUDENT

No. F-36

PRODUCTION OR MANUFACTURING

TOOL INVENTORY

Objective:

Given a typical inventory form, the student will make an inventory listing of all the small tools in the laboratory.

Activity:

1. Select another student to work with you.

2. Take a survey of the different kinds of tools in the lab.

3. List the different kinds of tools and then arrange them in tool groups. Example: all the different kinds of pliers - long nose, gas, side cutter, etc. should be placed within one group.

4. Present your tool group list to the supervisor or teacher for verification.

5. Obtain as many inventory forms from your teacher as you have tool groups.

6. Begin by writing the name of the tool group in the place provided for on the inventory form.

7. Proceed by listing the name of the tool and the other information requested on the form. (See sample)

8. Use a separate inventory form for each group of tools listing the information requested until you've completed the inventory.

9. Present the inventory lists to the teacher.

REFERENCE SHEET FOR STUDENT PACKAGE NO. F-36

Sample inventory

TOOL INVENTORY

TOOL GROUP Hammer Date ____________

Name of tool	Brand Name	Description	Quantity
Claw hammer	Stanley	16 oz.	2

Note:

Name of tool - use only tool names as they might be listed in a tool catalog.

Brand name - use manufacturer names.

Description - this entry might be a number, length, weight or shape as the tool might be described, briefly, in a catalog. The catalog is a good reference for you to use as a guide in tool description or identification.

Quantity - this is the quantity of each tool on hand.

[illegible]

1. Pertinent catalogs should be made available to students for use as a reference.

2. Prepare a supply of forms similar to the following sample.

TOOL INVENTORY

Tool Group ______________________ Date______________

Name of tool	Brand name	Description	Quantity

PRODUCTION OR MANUFACTURING

EQUIPMENT INVENTORY

Objective:

Given typical equipment inventory cards and a list of the equipment in the lab, you will prepare one card for each piece of equipment entering all obtainable information requested on the card.

Activity:

1. Obtain a list of all lab equipment from your teacher. If none is available, make one and present it to the teacher for approval.

2. Obtain sufficient number of EQUIPMENT INVENTORY CARDS. You will complete one card for each piece of equipment. See your teacher for the cards.

3. Taking one piece of lab equipment at a time, enter all the information, requested on the card, that you can find or locate on that piece of equipment.

4. After entering the information, you were able to obtain, one card for each piece of equipment, present all cards to your teacher for approval.

5. File the cards in the appropriate file.

6. See the foreman for your next assignment.

TEACHER REFERENCE SHEET FOR STUDENT PACKAGE NO. F-32

1. Prepare 100 equipment inventory cards. See Sample.

2. Have available equipment catalogues so that students may be able to obtain pertinent information not available from equipment.

3. If possible, make available old equipment purchase orders of lab equipment.

SAMPLE OF AN EQUIPMENT INVENTORY CARD

EQUIPMENT INVENTORY							
DATE				LAB			
MACHINE				TYPE			
MANUFACTURER							
MANUFACTURER'S ADDRESS							
SERIAL NUMBER				DATE OF PURCHASE			
SIZE				CAPACITY			
LIST REPAIRS ON BACK OF CARD							
MOTOR NAME	SERIAL NO.	CURRENT	H.P.	PHASE	CYCLE	VOLTAGE	RPM

FOR THE TEACHER No. F-39

PRODUCTION OR MANUFACTURING

DEPRECIATION

Objective:

Given a discussion on depreciation of equipment, the student will be able to develop a depreciation plan for a piece of equipment to the satisfaction of the teacher.

Activity:

Discussion:

Production or manufacturing equipment will eventually wear out or become too old making it difficult, sometimes, impossible to obtain replacement parts to make the equipment operational again.

What do we need? We need a careful plan for depreciating present equipment and for establishing a replacement budget request to management at a time when a piece of equipment must be replaced. For such a plan, we must know the original cost of the equipment, its expected life, the scrap value, and replacement cost.

Once an inventory has been made of existing equipment, listing date of purchase, cost, number of years used, future expected life, and replacement cost, a plan can be established for an equipment replacement budget. Unfortunately, some of the costs must be guesses, which presents some problems because individuals will place values, on equipment, according to their opinions. There are, however, certain guidelines that may be followed.

Perhaps, the best source of information for methods of depreciation, life of typical equipment and establishing scrap value are guidlines developed by the Internal Revenue Service of the federal government, state and local tax collection agencies. If one is depreciating equipment, for tax purposes, these depreciation schedules of the various governmental agencies must be strictly followed.

The simplest depreciation system, also the most common to use, is the straight line method. See sample on next sheet.

REFERENCE SHEET FOR TEACHER PACKAGE NO. F-39

Sample Depreciation Plan

Depreciation of a 1970 automobile:

Cost of car when new----------------------$2500.00

Expected life of car (estimated)-------------5 yrs.

Scrap value of car (at end of 5 years)------$10.00

Method of depreciation = Straight line.

Usually, an additional depreciation is allowed the first year. (about 10% of purchase price)

Calculations;

10% of $2500.00 = $ 250.00 This amount is added to the first year depreciation.

Balance to be depreciated over 5 year period:
$2500 - $250.00 = $2250.00

$2250.00 divided by 5 (life of car) = $450.00

Total 1st year depreciation = $250.00 plus $450.00 =	$700.00
2nd year depreciation..............................	450.00
3rd year depreciation..............................	450.00
4th year depreciation..............................	450.00
*5th year depreciation..............................	440.00

NOTE: Since the car has a scrap value of $10.00, established in the beginning, this amount must be deducted from $450.00 on the 5th year.

PRODUCTION OR MANUFACTURING

ALTERNATIVES FOR A CLEANER ENVIRONMENT

Objective:

Given a discussion on environmental pollution, the student will be able to list at least 3 alternatives for avoiding or controlling a pollutant in a post test.

Activity:

Discussion:

Enormous strides can be made toward a cleaner environment if existing technical know-how is applied.

Pollution avoidance or control can and should entail more than straight forward installation of hardware. According to the American Chemical Society, there are five basic alternatives for avoiding or controlling a pollutant or its precursors:

1. Select process inputs, such as fuels, that do not contain the pollutant or its precursors.
2. Remove the pollutant or its precursors from the process inputs.
3. Operate the process so as to minimize generalization of the pollutant.
4. Remove the pollutant from the process effluent.
5. Replace the process with one that does not generate the pollutant.

Examples of how these are being applied or considered today include: Power plants switching from coal to low-sulphur fuels, detergent makers looking for a non-phosphorous product, installing special lid-lifters on coke ovens (like those for Ford's Rouge Plant), reclaiming sulphuric acid from plating waste, and adopting electric furnaces.

Post Test:

List at least 3 alternatives for avoiding or controlling a pollutant.

FOR THE TEACHER

No. F-41

PRODUCTION OR MANUFACTURING

CLEANING THE AIR

Objective:

Given a discussion on air pollution, the student will be able to list at least 3 methods used to clean the air and give one example of a pollutant removed by each method in a post test.

Activity:

Discussion:

Perhaps, the most is known about avoiding and controlling air pollution. The know-how for controlling some air pollutants is limited, however, and existing schemes require further research and development before becoming economically feasible.

Some devices, for cleaning atmospheric and stack-gas air, are designed for low material loading, as for supply air to homes, offices, and factories. Numerous other devices handle high material loadings, as in industrial process, exhaust and stack-gas applications.

The following is a list of common air pollutants:

1. lint.
2. dust.
3. fumes.
4. smokes.
5. mists.
6. gases.
7. vapors.
8. odors.

Typical established ways to remove the above pollutants are:

Bag-type filters. Cloth bag or fiber used to remove lint and dust. Good examples (vacuum cleaners, auto air filters).

Electrostatic precipitators. A screen, constructed of metal wire, charged with voltages from 25,000 to 100,000 volts. The electrostatic charge attracts the pollutant and holds it. The voltage is then shut-off permitting the particles to drop into a recepticle and then discarded.

Dry inertial collectors. Large particles are either drawn or forced through a pipe by a fan and into a chamber. Speed of air, in the chamber, allows pollutants to drop into the bottom to be removed later.

Absorbers and adsorbers. Specially constructed chambers through which polluted air must pass. May contain special absorbing material (could be liquids) which remove fumes, and gases. Generally, used where high temperatures. Examples: Auto oil and exhaust filters.

Scrubbers. Polluted air is drawn through a chamber which contains water or other liquid to remove mists, vapor odors as well as particles. Example: oil type air cleaner used in an automobile.

Post Test

List 3 methods used to clean air and give an example of one pollutant removed by each method.

CLEANING METHOD (AIR)	EXAMPLE
1. ______________________	______________
2. ______________________	______________
3. ______________________	______________

FOR THE TEACHER No. F-42

PRODUCTION OR MANUFACTURING

GETTING RID OF SOLID WASTE

Objective:

Given a discussion on the reduction of material volume, weight or converting it into a less offensive form, the student will be able to list at least 4 methods commonly used to dispose of wastes in a post test.

Activity:

Discussion:

Chief aims of solid waste disposal efforts are to reduce material volume and weight. These steps convert the material into a less offensive form and/or make it more readily disposable.

Treatment of solid wastes:

Incineration. A method employing burning. This reduces wast volume about 80 to 85%. Examples: burn barrels, and specially burners. Almost every shopping center has one located at the rear of certain structures.

Compaction and Incineration. First packing or compressing the solid waste and then burning it. This reduces waste volume about 95%.

Sanitary Landfills. Dumping the solid waste into old mine excavations, caves or other unusable land and then covering it with soil. This reduces solid waste volume only about 33%. The kind of waste is limited to that which will not compress such as concrete etc.

Composting. Involves a process of "rotting". Is limited to organic materials such as fruits, slaughter waste etc. Reduces solid waste to about 40%.

Success with solid waste disposal lags behind the efforts to control air and water pollution. This is, to a large extent, due to political situations. The cost is high when a plant makes any changes in methods of disposing any waste. Such costs must eventually be borne by the consumer.

The Bureau of Solid Waste Management is a department within the HEW which is concerned with the problems, nationally, of pollution matters. It monitors all disposal processes for their collective, net effect on our environment.

Post Test:

List 4 methods commonly used in the disposal of solid waste materials.

FOR THE TEACHER No. F-43

PRODUCTION OR MANUFACTURING

SUGGESTIONS

Objective:

Given a discussion on guidelines and values of suggestions from workers, the student will be able to prepare and submit suggestions according to the guidelines. The merits of the suggestions will be evaluated by a committe of peers and the teacher.

Activity:

Industry, business, and ultimately society, have benefited from suggestions submitted by rank and file workers. Occasionally, very, very simple, minor suggestions have solved personnel difficulties, reduced volume of business forms, reduced cost of a product by increasing production and processing efficiency. Material substitutions have, very often, improved the durability and quality of a product. There is no limitation on suggestions, but they must be forthcoming to be tried.

GUIDELINES FOR PREPARING A SUGGESTION:

1. Will it reduce cost (save money)?
2. Will it increase production?
3. Will it reduce production time?
4. Will it reduce waste?
5. Will it lead to a by-product at little or no cost to the company?
6. Will it increase sales?
7. Will it improve safety?
8. Will it reduce worker fatigue?
9. Will it reduce absenteeism?
10. Will it solve, or improve anything?

REFERENCE SHEET FOR TEACHER PACKAGE NO. F-43

Following the discussion, supervise the formation of a committe, consisting of at least 5 members, to evaluate the suggestions as they are submitted. The committe will determine the merits of each suggestion, finally, determining which ones should be tried. Subsequent to the selection of a suggestion, some means of rewarding the individual, who made the suggestion, should be decided upon. Industry, and business, usually present the recipient with a cash bonus. This is not proper in most schools, but a certificate could be awarded to the deserving student during a general school awards assembly.

Construct a suggestion box and locate it in a conspicious place for students to deposit their suggestions.

FOR THE TEACHER

DISTRIBUTION

SHALL WE ADVERTISE

Objective

As an industrial arts teacher, you may be dismayed by the thought of teaching advertising. It is hoped that by reading this section, you will realize the importance of teaching advertising as an integral part of a general industrial arts curriculum.

Activity

Advertising is an integral part of the industrialization process. All of us are affected and exposed to it everyday. If industrial arts is an examination of the totality of industry, it is essential that we teach this facet of industry which affects, influences, and even controls our very lives.

Advertising is a twenty billion dollar a year industry, employing a tremendous number of people from the newspapers to the television industry. As a part of a study of occupations for the purpose of vocational guidance, it then becomes essential that industrial arts educators teach the general concepts of advertising. By teaching advertising, students are exposed to a broad based occupational outlook. The student learns about jobs in the advertising or communications industry. This is a broader approach than an examination of only the graphic arts or printing industry.

It is part of an approach toward relevent education that will help industrial arts meet its objectives as specified in the introductory materials to this curriculum.

FOR THE STUDENT

No. G-2

DISTRIBUTION

CREATING AN ADVERTIZING AGENCY

Objective:

As head of advertizing, you will establish an advertizing division, using the various departments listed below. This division will then create at least one ad for your product.

Activity:

In order to create effective advertizing you will have to organize a group of students that will assume responsibility for certain sections of advertizing. These students will do the work that is needed by these departments and design an ad for your product. Gather the students that are going to work for you, and give them a description of what each department does. Ask if there is anybody that would like to work in each department. After you have read a description of what each department does, ask if there are any more volunteers for the departments you have described. If there are any departments that still have to be filled, you will have to appoint somebody to that department. As you give a brief description of what each department does, mention that there are other packages describing in detail what each department does. It will help if you write down the names of the people and the department that they are in, because you will be responsible to see that they do their department's work. You may now read the description of each department, or describe it to your fellow students.

Research

This is probably one of the most important parts of advertizing. It covers the product and the groups of people who will buy it. You will have to find out who and what kind of people will buy your product so you can determine the target for your advertizing. This research may have been done by the research and development division. Check with them and see if they have done the advertizing research.

Media

The media department works closely with the research department. When the research department decides who they are going to direct their advertizing campaign at, it is up to this department to decide which media will be most effective in reaching this group. For instance, if the person who will purchase the product is a fellow student, the school newspaper might be the best place to advertize. If it is the student's parents, then the best type of advertizing might be direct mail or the distribution of flyers or leaflets around the neighborhood of the school. You can find more information under the package titled "What Type of Advertizing Shall We Use."

Copy

The copy department is responsible for all the printed words in the ads. It will be up to you to decide on what words to use, and what size and style of type to use in the ad. It may help to ask the English, Arts, and Graphics Arts teachers for assistance in this problem. The important thing to remember is who you are trying to sell the product to, and direct your advertising copy to them.

Art Department

This department prepares all the drawings to be done for the ad. Members of this department should look at professionally prepared ads, especially those that deal with a product similar to yours. You will have to know how big the ad will be, and what it should look like. The other departments should give you this information. It may help if you ask the art teacher for help and advice. You will have to tell the class what you want them to do, how big it should be, and what it will say. You will then have to pick out the design that you consider will do the job best.

Print Production

This department has to do the layout and printing of the ad. You may choose a variety of methods and techniques for producing the ad. Some of the methods which you can use are Silk Screen, Woodcuts, and Linoleum Blocks. There are instructional packages in these areas, or you may ask the printing teacher for help in some of the more sophisticated techniques.

FOR THE STUDENT

DISTRIBUTION

DESIGNING AN AD FOR A STUDENT NEWSPAPER

Objective:

You will design an advertisement for our product that will be placed in the school newspaper.

Activity:

1. Go the the office of the school newspaper, or one of the officers of the paper, and find out the cost of the various sizes of ads. Also inquire as to whether you have to prepare your own art work, or if they will prepare it for you. Also check whether or not you will have to prepare a linoleum block, woodcut, or silk screen design of the ad or if they do it from your design preparations. In some school newspapers they prepare the paper on a mimeograph machine. In this case, ask a friend that can draw or the art teacher for help.

2. After you find out this information, report back to the advertizing committee. The entire committee should now make the decision on how much to spend and the type and design of the ad.

3. The committee will now prepare the ad. The first thing to do will be to get a newspaper and study the various types of ads in the newspapers, especially any that are similar to the type of product you are selling.

4. Now measure the size of the ad as it will appear in the school newspaper.

5. The person that is able to draw should prepare a picture of the product in the space that the ad will go in.

6. Now the committee will ask a fellow student that has had printing, or the printing teacher, what size and style of type he should use.

7. If you have to prepare a woodcut, linoleum block, or silk screen to have the ad printed, you may get the proper package or ask the printing teacher or art teacher for help.

Post test:

You will prepare the ad in its design form and get an O.K. from the teacher. Then you will prepare the linoleum block or whatever you need for the school newspaper. Get a test copy of the ad to be sure everything is correct. When everything is correct, show it to your teacher for his final O.K.

DISTRIBUTION

WHAT KIND OF ADVERTISING SHALL WE USE?

Objective:

As head of the advertising media department, you will be responsible for deciding on the type of media to use in your advertising campaign.

Prerequisite:

Packages G-2, G-3, and G-61.

Activity:

1. Read the descriptions of the various media, and make the decision on which media you will use, based on information from Packages G-2, G-3, G-61, and the information supplied by this package.
2. Consult with all the members of your advertising department before you make your final decision.
3. Present your decision to the entire company for their review and consideration.

NEWSPAPERS

Newspapers are one of the most popular forms of advertising, because of their ability to reach large populations in small geographic areas. Because of this, certain manufacturers may advertise in certain regions of the country. A ski manufacturer would normally advertise in northern papers since most skiers come from this region. Newspapers also appeal to advertisers because their ads can appear in special sections designed specifically for a certain segment of the readers. For example, a manufacturer of certain items that appeal mostly to men may advertise in the sports section. One of the most beneficial aspects to the advertiser is that ads can be inserted quickly, based on weather, local events, or national situations. There are also small local weeklys that take care of the small local businessman who can't afford to advertise in a large newspaper that will reach a large percentage of customers who will not shop at his store. If you decide to use a newspaper ad, you might want to consider a local paper. Perhaps the school newspaper (if you have one) would be best.

MAGAZINES

Magazines have a dual approach toward advertising. They direct their advertising on a national and a regional basis. Although basically a magazine deals with national advertising, there has been a strong trend toward regional advertising in recent years. The big problem with magazines is in the large amount of time needed from the submittal of the ad to its actual publication. Trade magazines appeal to manufacturers of limited usage products. These manufacturers use trade magazines because they appeal to customers that have an interest in their particular products. For example, a woodworking tool manufacturer might advertise in a home handyman magazine.

RADIO

Radio has an advantage in that it serves a large geographical area, and certain stations are listened to by certain groups of people. A sports program would tend to attract men, and therefore men's clothing manufacturers would direct their advertising to these stations. Television and the transistor radio have also had a large impact on radio advertising and programming. Television has taken a large part of the adult audience, leaving a void that was filled by the transistor radio, with its low cost and compactness. The increase in the amount of teenagers owning radios of their own has led to the tremendous amount of teenage radio programming. As a public service, certain radio stations will broadcast local public announcements.

TELEVISION

Television is the second largest advertising medium, as it is able to present a visual presentation along with the audio presentation. Research has been conducted by many groups to predict the type of audience who will watch a particular type of program. Because of the high cost it is usually used by large advertisers who are trying to reach large groups of customers for mass sales.

DIRECT MAIL

Direct mail can be selective or massive, depending on what the advertiser wants. Direct mail in certain fields depends on the information and the mailing list that the advertiser uses. It is also used by local businesses who will mail advertisements to potential customers within a specified area of the store or stores. This is also one of the ways political candidates use to advertise their qualities to the public within certain areas. This is also done by handing out or distributing flyers for certain products.

BILLBOARDS

Billboard advertising is used by advertisers for a quick eye appeal, for introduction of their product, so that a driver can read the sign at a glance. It can be used by small local advertisers in a one sign advertisment. Or it can be used to advertise a local event by displaying posters in different locations or stores within a community. Its main advantage is that it can be used in a very limited local area.

OTHER ADVERTISING

Other advertising to a smaller extent included store displays, packages, sampling, catalogues, and advertising specialties.

TEACHER REFERENCE SHEET FOR STUDENT PACKAGE

The student will be able to decide on the type of advertising he wishes to use. He may choose more than one type but he should choose at least one of the following: School Newspaper, School Bulletin Board, Flyers, or the local radio station for a public service announcement.

SUGGESTED FORMAT FOR A CASSETTE, OR CASSETTE AND SLIDE PRESENTATION

Information	Cassette Background	Suggested Slides
Newspapers	Light background music and/or a platen press	1. Two slides of a large newspaper press 2. A platen press 3. Front page N.Y. Times 4. Front page local newspaper 5. School newspaper
Magazines	same as above	1. Time Magazine cover 2. Regional ad in Time Magazine 3. Sports Illustrated cover 4. Playboy Magazine cover 5. Popular Electronics cover
Radio	Popular music: Glen Campbell, the Temptations,etc.	1. Stereo Radio system 2. Portable Radio 3. Portable radio at the beach 4. Portable radio at a sporting event

Information	Cassette Background	Suggested Slides
Radio	Popular music: Glen Campbell, the Temptations, etc.	5. A boy walking along the street with a portable radio
Television	Theme from Mission Impossible	1. A color television ad
		2. Portable television ad
		3. A car ad on television
		4. An asprin ad on television
		5. A razor blade ad
Direct Mail	By the Time I Get to Phoenix; Glen Campbell	1. A sample received in the mail
		2. Two different types mail advertizing
		3. A political advertizment
		4. A flyer on a door
Billboard Advertizing	A busy street corner	1. Two local billboard ads (Try to include recognizable landmarks)
		2. Display ad in a small local store window
		3. School football schedule billboard
		4. Two of the school bulletin boards
Other Media	Light background music	1. Sears Catalogue
		2. Store display window

DISTRIBUTION

HOW MUCH SHOULD WE SPEND ON ADVERTISING?

Objective:

As head of the advertising section, you will determine the size of the advertising budget.

Activity:

This will be a hard task for you to accomplish, because there is no clear cut method that is used by advertising companies in determining budgets. It would be very easy for you to decide to spend 10 percent of the total cost on advertising, but this does not take much work or research, and may prove to be ineffective for your situation. It may be necessary for you to earmark 20 percent of the amount to be realized from your product to accomplish the desired result. Approach this in a logical succesion of steps, by which you will accomplish your objective. You will have to work with your research department to get the basic information, to help you make your decision. The final decision belongs to the Board of Directors of the corporation.

1. Find out the total number of products to be sold, the total cost of manufacturing the item, the suggested cost to the consumer for the product, and the total amount of profit. This information should be available from the Research and Development Department.
2. Determine the most effective way of selling the product at the lowest possible cost. Some of this information should be available from the media department.
3. Determine the cost of advertising in relation to the amount of sales.
4. Relate the amount that you feel will have to be spent on advertising to accomplish the task of selling your product.

It is safe to assume that, because of the limited amount of manufacturing done by your company, the amount that will be spent on advertising will be relatively small. Most of the work done in the advertising division will be done at a low cost, because it is being done in the school. Some of the costs to be considered are the amounts for paper and materials that may have to be bought. Also inks and silk screen materials may have to be bought. This process will take place after the media department has made its suggestions on the type of advertising to use.

SUGGESTED BUDGET OUTLINE

1. Cost of paper	$_____.___
2. Cost of inks	$_____.___
3. Labor cost	$_____.___
4. Cost of running ads in school newspaper	$_____.___
5. Cost of other commercial advertisements	$_____.___
6. Total cost	$_____.___

Post test:

Submit the budget to the Board of Directors for approval.

FOR THE STUDENT

DISTRIBUTION

CUTTING A LINOLEUM BLOCK

Objective:

Given a linoleum block, a design to be cut, and cutting tools, you will cut out the design on the linoleum block so that an acceptable picture will result when you test it on the printing test.

Activity:

You will need the following items to enable you to cut the linoleum block:

1. A linoleum block.
2. A dull soft lead pencil.
3. A set of cutting tools or gouges.
4. India ink, and a pen or brush for the ink.
5. The design of the ad.

Use the following instructions and complete each one before moving on.

1. Take the design of the ad and trace over it with the soft lead pencil. Bear down on the pencil so it leaves a heavy dark line on the ad.

2. Place the design of the ad face down on the linoleum block. Now take the pencil and rub back and forth on the blank side of the paper, so the design will be transfered onto the linoleum block.

3. Lift one small corner of the ad and make sure the design is on the linoleum block. If it is, take off the ad. If it isn't, rub some more.

4. Now take the India ink, and with a pen and brush, retrace the design of the ad in ink, so it will not wipe off while you cutting.

5. If there is any lettering in the ad, it will now appear to be backwards. This is correct. When it prints it will print correctly.

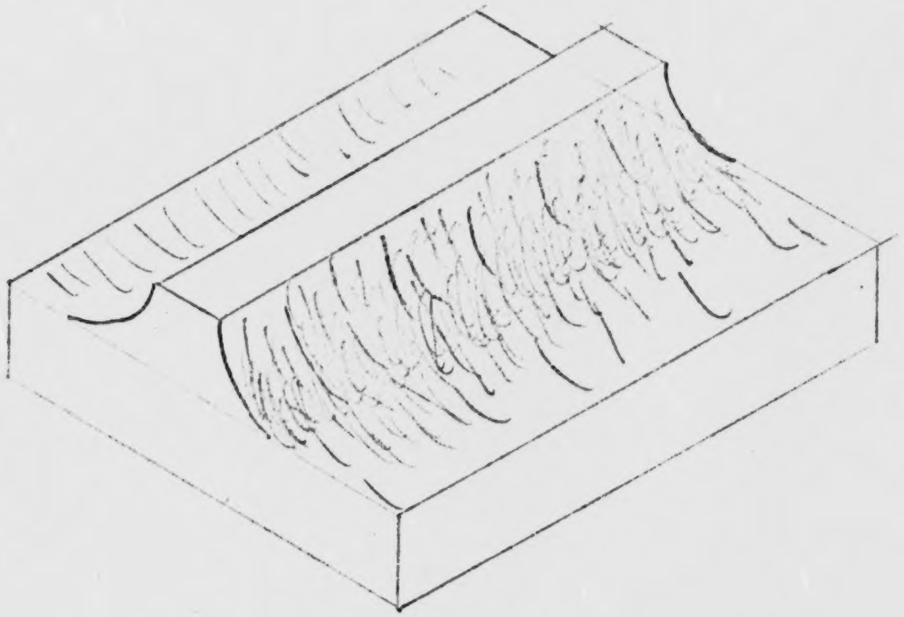
6. Clamp the linoleum block in a vise, or to a table, or place the linoleum block in a stop block.

7. Now take the cutting tools and practice using them on any large section that is going to be cut out. BE CAREFUL NOT TO PLACE YOUR HAND IN FRONT OF THE CUTTING TOOL WHILE YOU ARE WORKING.

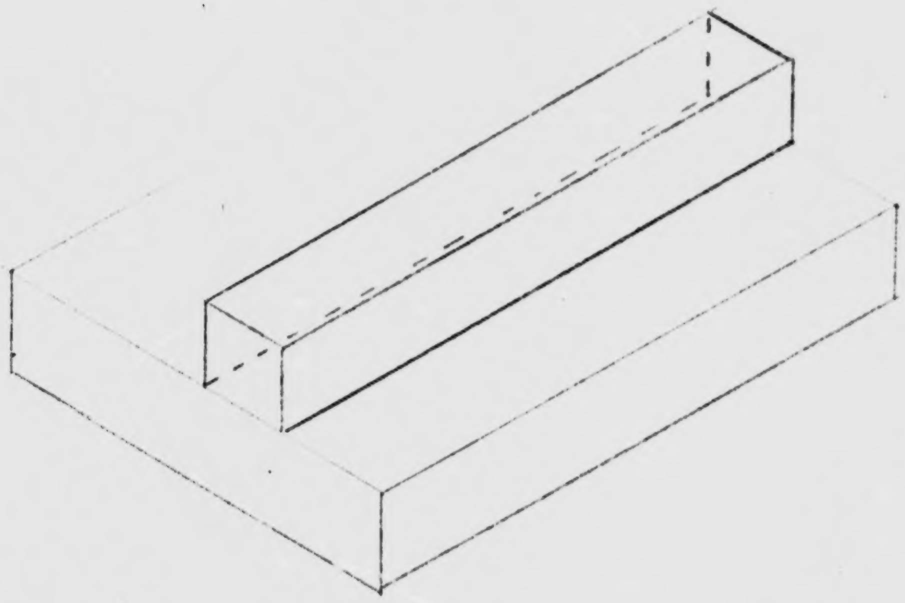
8. Start cutting out the design, working on the section that will have the largest amount of material left first.

9. When cutting out the design, make sure that the edges of the material have sloping sides like Figure A, and not sharp corners like Figure B. (See next page).

10. Finish cutting out the design, progressing from the larger details to the finer ones.



WILL NOT BREAK



WILL BREAK

DISTRIBUTION

DEVELOP A FLYER TO BE PRINTER AND DISTRIBUTED

Objective:

You will work with the advertising department to design, print, and distribute a flyer to individuals who may purchase your product.

Activity:

1. Get some samples of advertizing flyers used by other companies.
2. Decide on whether your flyer will be on one page or more, printed on one side or both.
3. Decide on the size of the paper to be used for the ad. It is easier if you stay with a standard size paper that is readily available to use.
4. Work with the advertising department to determine the size of the ad, and how many you will need. The decision on how many you need will be determined either by Research and Development, or by the research department of the advertizing agency.
5. Be sure to include in the flyer where and how your item may be purchased. This information may include; the school address, the address of your school representatives, a school or home telephone numbers, and the hours your distribution service will be open, so you can take orders and arrange for delivery.
   BE SURE YOU ASK FOR YOUR PARENTS PERMISSION TO USE A HOME TELEPHONE BEFORE PUTTING IT ON THE AD.
6. If the product is for fellow students, you may ask permission from the principal to distribute the flyers at lunch, or permission to be excused from class to distribute them to the students in their homerooms. If given out at lunch, ask a few students to help. If they are going to be distributed during homeroom or after school make sure you have enough help to cover all the exits that the students use. It is highly recommended that you use two students at each door, and encourage all students not to litter the streets.

7. If it is to be distributed to adults in the neighborhood of the school, you will have to get a map of the general area of the school. Count the number of streets and divide this by the entire number of students in your class. When you have a list of the streets it might look like this:

Area One	Area Two	Area Three
A St.	First Ave.	West Ave.
B St.	C St.	Park Drive
Second Ave.	Third Ave.	Macy St.
Park St.	Sea St.	Harvard Park

Call the class together, read the areas and the streets involved, and ask for volunteers for each area. When you have a volunteer for an area, write his name down. Each student will deliver the flyers to homes in his area on the day assigned for distribution.

8. The day after the flyers have been distributed, go to school early and ask a number of students if a flyer was brought to their homes last night. Check the address of the student with the area to make sure all the flyers were delivered.

If any areas were not delivered, go back to your distributor and find out why.

DISTRIBUTION

DESIGN A POSTER FOR THE SCHOOL BULLETIN BOARD

Objective:

To produce a poster or posters for the school bulletin board.

Activity:

As head of the advertising department you will have to coordinate and direct the efforts of the Art, Copy, and Print departments to produce a poster.

1. The ideal size for a bulletin board poster is considered to be 11" x 28". You must tell the art and copy department the size you have permission to make, or have decided to make.

2. The copy must use the methods discussed in package G-60, plus some special rules that are used for posters. The copy should be printed in simple block style, and in large type that can be read easily by a student as he walks by the bulletin board. The copy must be brief and to the point. It should not contain over eight words as a general rule. Give the art department the wording for the copy and the size and style of type to use.

3. The art department will be responsible for the art work on the poster. If it to be a single poster you may paint a picture of the product on the poster. If it is going to be more than one poster you will do the art work according to the directions of the printing department and the method they are going to use to produce the posters. The Art department will make the recommendations for the colors to be used in the ads. The most effective colors for posters are:

   Black on Yellow
   Green on White
   Red on White
   Blue on White
   White on Blue

4. The Printing department has the sole responsibility for reproducing the posters. You will decide on the method you are going to use and work with the Art department in making necessary preparations for reproducing posters.

Post test:

As head of advertizing you will see that the posters are produced on schedule and according to the rules you have established.

DISTRIBUTION G-11

FOR THE STUDENT

PREPARING A RADIO ANNOUNCMENT

OBJECTIVE

You will write a commercial that will be brodcast on a local radio station

PREREQUISITE

Package G- 60

ACTIVITY

1. Certain radio stations make public service announcements for the local community free of charge.

2. Ask your fellow students if they know of any stations in the area that make public service announcments: If not ask them to ask their parents if they know of any radio stations that make public service announcements.

3. After you recieve the call letters of the station, look up the address in the telephone book.

4. There are various types of commercials used in radio:

   A. The live commercial, in which the announcer reads the material that is sent to him.

   B. Transcribed commercials, which offer complete control over the advertising. They permit complex scripts, more than one actor, musical accompaniments, and sound effects.

   C. Straight commercials, are probably the easiest to write, as the announcer only follows the script.

   D. Dialogue commercial, is one which consists of two people discussing the product.

   E. Dramatic Commercial, is a commercial that consists of a brief story or play.

   F. Singing commercials, are commercials which consist of musical backgrounds, or a group singing a musical jingle.

5. Select a type of commercial,

6. Depending on the type of commercial, you may go to three people in the school for help.

   A. The english teacher for help with writing the script, and for the speaking during the ad.

B: If it is to be a singing commercial, ask the music teacher for help in planning, musical background, and for the direction in singing the ad with your fellow students.

C. The third person is the audio visual specialist, he can help you with running the recording equipment. and with writing an effective commercial.

6. When you write the commercial, you have to use words or techniques which will get the attention of the listener.

7. You should read the copy aloud constantly while you are writing it, so you can judge how it sounds. It would also be a good idea to tape the announcement and listen to it for critical comments and effectiveness.

8. Speak in a normal conversational tone.

9. After you have decided on the type of ad, you would like to produce write the radio station for permission to use this method.

POST TEST

1. Write the proper commercial script.

2. Produce the script on tape.

3. Send it to the radio station to be brodcast.

FOR THE STUDENT

WHAT IS THE PURPOSE OF PACKAGING A PRODUCT ?

OBJECTIVE

You will decide whether or not to package your product.

ACTIVITY

1. Get the people in your department, and meet with the people from research and development.

2. Sit down and discuss whether or not your product will be shipped or mailed. Also, discuss the possibilities of damage, if a student drops some items while he is delivering them.

3. If your group feels that there is a possibility that the product may have to be mailed or may be damaged during delivery, you will have to develop a process to package your product.

4. The first concern of a package is that it must protect the product. You may find that package G-14 will help you.

5. The second item of concern is the cost of the various materials used to make a package, and the possibilities of using them. Packages G-14 and G-18 may be of help.

6. If the marketing research department has decided to sell the product on the open market, in drug stores, variety stores, local merchants, etc. You will have to design a package that serves the above purposes, and also is designed so it becomes an attractive selling device. This design and printing of the package would be performed by the advertising department, on the package that you have developed according to package G-16

DISTRIBUTION

FOR THE TEACHER

EXAMINE SOME PACKAGES THAT ARE SIMILAR TO THE PRODUCTS WE ARE PACKAGING

OBJECTIVE

To examine how a package is designed and formed, then design a package for the product.

ACTIVITY

1. Ask each student to bring in a empty package of a product similar to the one you are manufacturing.

2. If you feel that there is no similar product, ask for a package that is similar in size to the product you are manufacturing.

3. Examine the packages for:

   A. Types of material used in construction.

   B. Design of the package.

   C. The way it was folded and put together.

   D. Any material inside to keep the product from moving, or otherwise protect the product.

   E. The manner in which the package was glued, taped, vaccum formed or otherwise formed.

4. Determine whether enough of a certain type of pre-made packages can be brought in or bought and used to package your product.

DISTRIBUTION

FOR THE STUDENT

TYPES OF MATERIAL AVAILABLE FOR PACKAGING

OBJECTIVE

You will know what materials are available to use in packaging, and make a decision,on which type you will use for your product.

ACTIVITY

1. One of the most common materials used in packaging is cardboard. It is available in many thicknesses and strengths, can be waterproofed, folded, bent, glued, stapled, and printed upon. It is readily available, and can be processed in a school shop. It will probably be the easiest item for you to use.

2. Wood can be used to make a strong package. If you are making a fairly heavy item that you will have to ship, you might consider wood. Wood can also be used to make a highly attractive package design. The drawback to this is its cost.

3. Tape and film, Scoth brand makes various types of tape that will solve a number of problems. Because of the wide number of tapes and their uses, we will not discuss them in detail. You may inquire at a local store, or write

3M CO.
ST. Paul 55419 Minn.

Film is a comparitively new process developed in the past few years. A clear plastic film is put over a frame. The product to be wrapped is then brought next to the film. The frame is heated, causing the film to stretch and cover the product. The film is then broken off by a cutter. When the heat from the frame is removed the film shrinks, sealing the product to a piece of cardboard or other material. Razor blades often come in a package of this type.

4. Product protection. There are various types of packing that can be used to protect a product in a package. You may use cotton (expensive), newspaper (cheap), styrofoam (moderate), or popcorn (delicious). Because of its nature, popcorn proves to be a very reliable means of packing a containerso a product won't move or be broken. It also can be eaten, so if you use popcorn, bring in an extra can for your fellow students, or you'll have none for the package.

DISTRIBUTION

FOR THE STUDENT

SUBCONTRACTING THE PACKAGING OPERATION

OBJECTIVE:

You will examine all considerations regarding the packaging of your product, and decide whether to produce it youself or subcontract parts of, or the entire packaging operation.

PREREQUISITE

Packages G-18 and G-15

ACTIVITY

1. Almost all companies subcontract parts of their packaging process.

2. Subcontracting can consist of buying the materials, having the packages premade, or having the printing done by another company.

3. You will have to decide on how much of the process you want done by yourselves, and what you need to subcontract.

4. Go to the English teacher and and ask if he or she would help you write a buisness letter.

5. This business letter must include the questions you need to ask the packaging company. The following information should be included:

   A. The size of the package needed.

   B. The type of material wanted: paper, light cardboard, heavy cardboard, etc.

   C. The number of packages needed, and the cost for this number.

6. Have the letter approved by the corporation and your teacher.

7. Go to the office and ask for some writing paper with the school's letterhead.

8. If your school has a class in office practice ask the teacher if one of the students could type this letter for your class.

9. When you get the return letter, you will have to estimate the cost of materials and decide on which process to use.

TEACHER PACKAGE

DISTRIBUTION

HOW GOODS GET FROM THE MANUFACTURER TO THE CONSUMER, A GENERAL INTRODUCTION

Objective:

The student will state the definition of the following terms: distribution, manufacturer, producer, consumer, and middlemen.

Activity:

Give a few introductory statements on the distribution of commodities. Such as--what is its major responsibility? Explain some of the means it has to use to fulfill the responsibility. Why use middlemen in distribution? There is an attached sheet with some introductory statements on it.

Ask the students to define these terms: distribution, manufacturer, producer, middlemen, and consumer. If their response is not to your satisfaction, then let them use the hand-out sheet with the terms on it. Definition of terms is on the next page.

Post test:

Direction: Write the definition for each of the following terms.

1. Distribution
2. Manufacturer
3. Consumer
4. Middlemen

DEFINITION OF TERMS

No. G-19

(For Students)

1. Distribution-is the means by which goods of producers or manufacturers are made available to meet consumer needs.

2. Manufacturer-is one who combines one or more materials to produce, bring forth, or generate a new product for consumer needs. It may be a factory or an individual.

3. Producer-one who grows agricultural products, or manufactures crude materials into articles of use for the consumer.

4. Consumer-is the buyer of the goods produced by the manufacturer, or producer.

5. Middlemen-is the business organization that specializes in carrying out the transfer of goods between the producers and consumers.

INTRODUCTORY STATEMENTS

(For Teacher)

The goods produced by man flow through many channels between the raw stage and finished product. Most industries refer to this flow as distribution channels. To a mining company engaged in extracting ore from the ground, the flow of distribution may take its goods to a refiner, then to a manufacturer, perhaps by means of middlemen, and eventually to the consumer. At several points in this process, other streams enter in the form of different materials and change the nature of the product flowing through the channels toward ultimate consumption. At various points, materials are held in stock, creating pools of inventory along the way before reaching the consumer.

The concept of distribution differs at each stage along the way. To the company mining iron ore, the immediate customer is the steel mill, but the end user of the steel might be an individual like you or me. To the steel company, the immediate customer might be a manufacturer, who in turn sells through various intermediaries, to the ultimate consumer. This process goes through middlemen then the consumer.

The manufacturer has to be concerned not only with the immediate customer, (middlemen) but also the ultimate consumer. They all play an important role in the flow of goods.

Today manufacturers use direct and indirect means to flow their goods. When using the direct method the goods go from the manufacturer to the consumer. The indirect method the goods go from the manufacturer to the middlemen and then to the consumer.

FOR THE STUDENT — No. G-20

DISTRIBUTION

THE ROLE THAT TRANSPORTATION PLAYS IN THE DISTRIBUTION OF GOODS.

Objectives:

1. You will be able to explain the role that transportation plays in the distribution of goods.
2. You will observe the transportation flow of a material from the raw state to a finished product.
3. You will be able to tell the teacher the principal transportation methods used by industry today.

Activity:

1. Copy these four statements in your notebook.
    1. For manufacturers and middlemen, transportation serves the purpose of moving materials from stage to stage, and from manufacturer to middlemen to consumer throughout the production and distribution processes.
    2. The principal transportation methods used by industry today are railroads, highways, airlines, pipelines, inland waterways, and sealanes.
    3. The transporation industry may also be called the carrier industry.
    4. The types of carriers are:
        - A. Common carriers which serve the general public.
        - B. Contract carriers which operate "for hire" under separate contract with each shipper; routes, rates, and services may vary from shipper to shipper.
        - C. Private carriers, which use their own equipment for transporting their goods.
2. Go to the shop foreman and ask for slide and audio presentation number G-20.
3. Set up the slide and audio equipment.
4. View the presentation, then stop the machine and return all equipment.
5. Review the notes you copied in your notebook.
6. Complete the post test on the next sheet and show it to your shop foreman.

Post test:

Directions: Read the statements below and fill in the answers.

PART I

1. What major role does the transportation industry play for manufacturers and middlemen?

____

2. Name at least three principle transportation methods used by industry today.

____

____

____

3. Give another name which the transportation industry may be called.

____

PART II

Directions: Read the statements below, and write true on your paper if it is a true statement, and false if it is a false statement.

________ 1. Common carriers are the group which serve the general public.

________ 2. Contract carriers operate for a fee under separate contract with each shipper; route, rates and service may vary from shipper to shipper.

________ 3. Private carrier is just another name for common carrier.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. G-20

Following is an example of a slide presentation used to transport goods from raw state to the consumer.

SCRIPT

Visual	Narration
1. Focus slide	1. Adjust the lens so the word focus is clear.
2. Opaque slide	2. In this presentation you will see some of the many ways in which transportation is needed to produce and transport an automobile.
3. Medium shot - Iron ore machine digging ore in the mine.	3. This ore machine transports the raw material from the earth into trucks and railroad cars.
4. Medium shot - Truck at the mill.	4. The material is transported to the mill for beneficiation. Trucks also transport materials to the plants.
5. Long shot - Conveyer belts moving the material at the mill.	5. During the different beneficiation stages the material is transported on conveyer belts.
6. Medium shot - A train transporting material from the mill.	6. The train is transporting materials to the automobile plant.
7. Long-shot - Boat transporting iron ore.	7. Boats are also used in transporting materials to the plants.
8. Opaque slide	8. At the automobile plant the material is moved from place to place by conveyer belts, trains, and trucks.
9. Long shot - Cars loaded on a railroad car.	9. After the automobile has been made it is shipped to middlemen by railroad, trucks, and boats.
10. Close up - A man getting into an automobile.	10. The final stage of transportaion is the delivery of the automobile to the consumer.

DISTRIBUTION

FACTORS THAT HELP A COMPANY CHOOSE A METHOD FOR TRANSPORTING GOODS

Objective:

1. You will state some of the criteria used by companies in choosing one method of transportation over another.
2. You will select the best method or methods for transporting some sample goods to the consumer, and state the reasons for your choice.

Prerequisite:

Completion of Package G-20.

Activity:

1. Study the related information found on Page 2-5.

2. Choose what you think would be the dominant method used for transporting the following goods: (Note: You must be able to tell why the method you choose seems superior to the other methods. Write your answer on a separate sheet of paper.

   A. What method would you use to transport forty cars from Ohio to Texas?

   B. What method would you use to transport iron ore from Minnesota to a Michigan steel plant?

   C. Ten families will be moving from Washington to Mississippi. What method of transportation would you use to transport their household goods? If they move from Washington to Puerto Rico what method would you use?

   D. What is the dominant method used by refineries to transport their goods to marketing areas? Why?

3. Give your answer sheet to the instructor.

It is the responsibility of the traffic department in most companies to determine the type of transportation to use for transporting goods. While trying to make this decision, they are influenced by a number of factors. The most important are: (1) the type of product to be shipped, (2) the availability of competing carriers, and (3) the relative importance to the shipper of speed, cost, and other criteria.

The traffic department must select the form of transportation which best meets the company's needs. The criteria for most companies are based on the following:

1. Speed--to save time and reduce investment in inventory.

2. Cost--because of its effect upon the price and profit of company product.

3. Accessibility--closeness of ternimal facilities to the supplier and the consumer.

4. Reliability--maintenance of regular schedules and services.

5. Adequacy--adequate quantity and quality of equipment, terminal facilities, and services.

6. Services--storage, pickup and delivery, special equipment, loading and unloading time.

7. Kind of product--perishable goods or non-perishable.

8. Restrictions--on federal, state, and local level.

For example, water transportation is superior to rail in the shipment of iron ore on the Great Lakes. Speed usually is not important, cost is relatively low, terminals are readily accessible, and the cargo schedules are reliable and adequate.

The advantages and disadvantages of each transportation system are very important to the traffic department. Look at each of the following systems:

RAILROAD

Advantages:

1. It supplies the inland shippers with the lowest cost for shipping heavy goods over long distances.

2. Railroad lines reach into almost all sections of the United States.

3. They are highly reliable in their schedules regardless of weather.
4. They provide store to door delivery in which goods are picked up or delivered at the shipper's place of business and all handling is done by the railroad.
5. They have in-transit privileges which permit the shipper to stop a shipment for storage or processing and then later resume the journey to ultimate destination.
6. A loaded car on route to a destination can be diverted to another destination.
7. Pool car service entitles the shipper of a car load of goods to have portions of the carload unloaded for buyers at different towns along the way.

Disadvantages:

1. The poor accessibility, for the shipper, of many railroad terminals.
2. Comparatively slow speed for short hauls.
3. The lack of flexibility in making up trains and in diverting or adding cars.
4. Rapid growth of trucking facilities have caused many small towns to be without rail service.

WATER TRANSPORTATION

Advantages:

1. It has the lowest cost for shipping of all the systems.
2. Large quantities may be transported in one vessel.
3. It has overseas shipping.

Disadvantages:

1. Slow travel time.
2. Reliability of service is reduced by inclement weather,

often reducing travel to seasonal periods.

3. Inland waterways are not available in many parts of the country.

4. Services are limited, with reliance on other forms of transportation for pickup and delivery.

MOTOR TRUCKS

Advantages:

1. No other system can compete with them in adaptability and flexibility.

2. Can reach every village, town, or city in the United States.

3. Their frequent service permits shippers to deep their inventories at a low level.

Disadvantages:

1. The cost for long distance hauling is high

2. The variation in trucking regulations among the States.

AIR TRANSPORTATION

Advantages:

1. Speed of delivery.

2. They transport long distance perishable goods without the need of freezing.

Disadvantages:

1. High cost for shipping.

2. Reliability of service is reduced at times by weather conditions.

PIPELINE TRANSPORTATION

Advantages:

1. Do not require packing the goods.
2. Low transporting cost.
3. They can transport goods continuously every minute in the day.

Disadvantages:

1. Most of the goods they are able to transport, must be in a liquid form.
2. Government regulation.
3. Inflexibile routes.

TEACHER PACKAGE

No. G-23

DISTRIBUTION

THE NEED FOR STORING GOODS

Objective:

The student will write at least three reasons why storage is necessary for manufacturers and middlemen.

Prerequisite:

Package number G-19.

Activity:

1. Introduction - In our complex economic system, goods are usually produced in anticipation of actual market demands. The storage function, therefore, must be performed. When there is a demand for an item, stock levels fluctuate all along the line of distribution. This means that manufacturers, wholesalers, and retailers all must hold stock, or inventories of goods, until a consumer demand arises.
2. Hand out sheet containing five needs for storage on page 2.
3. Have the students review the five main needs for storing goods.

Post test:

1. Give three reasons why storage is necessary for manufacturers and middlemen.
2. Answer yes or no to the following statements:
   A. As a consumer of goods; do you need storage?
   B. Do retailers and wholesalers need storage?
   C. Do manufacturers need storage?

FIVE NEEDS FOR STORAGE

1. Goods are stored to reduce seasonality in production and sales. For example, the manufacturer of Christmas ornaments has a market for his goods for just a few weeks before Christmas. These ornaments are produced equally throughout the year, however, utilizing storage to keep finished goods until the selling season.

2. Goods are held in storage to save money in other business operations. For example, the manufacturer who makes a product of many sizes may use the same machine to produce a number of sizes. He may often find it most economical to schedule long production runs involving several weeks' supply of each size at a time, instead of manufacturing the total needs of each size weekly.

3. Goods are held in storage to improve their quality and value. Products such as cheese, whiskey, and tobacco must be aged or conditioned to improve their flavor.

4. When transportation facilities are affected by weather, strikes, or other factors, storage is necessary.

5. The middlemen uses storage to keep his inventories in the exchange stores filled.

DISTRIBUTION

STORING YOUR MATERIALS AND PRODUCTS

Objective:

You will decide where and how much storage space is needed for the materials and product you are producing.

Activity:

A committee of two or three students will meet and decide the following:

1. Will the product have pre-cut materials? If so, decide how much space is needed to store these materials. Also decide where you will store these materials.
2. If the product is going to have semi-finished materials; decide where and how much space is needed for storage.
3. Decide where and how much space is needed to store the finished product until distributed to the consumer.
4. See if the instructor will approve the places you decided to store the materials and product.
5. After your storage places have been approved, explain to the class where all materials and the product are to be stored.

DISTRIBUTION

THE MARKETING CHANNELS OF DISTRIBUTION

Objective:

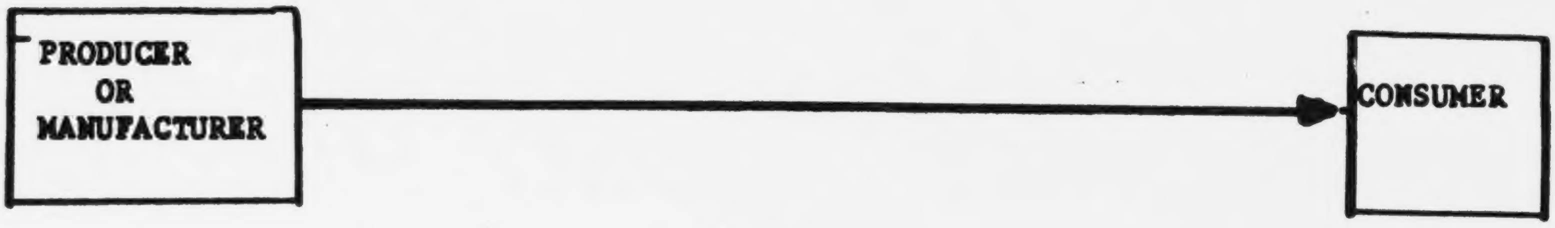
1. The student will explain, in writing, the difference between direct and indirect channels of distribution.
2. The student will state the difference between a retailer, wholesaler, and broker.

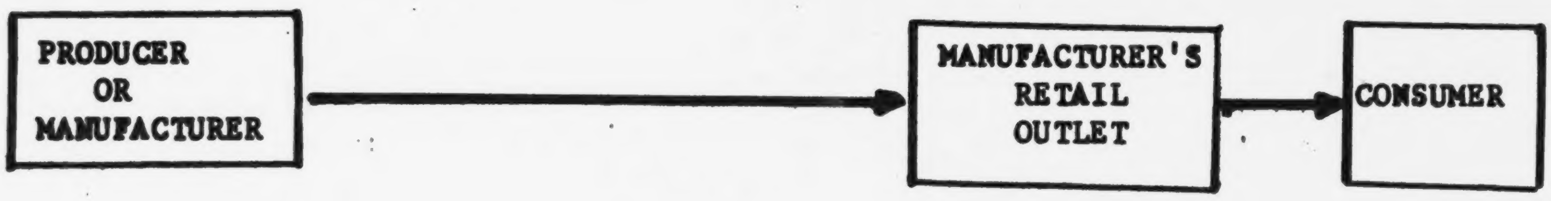
Activity:

1. Introduction - Marketing is a total situation or environment in which the resources, activities, and attitudes of buyers and sellers affect the demand for products, usually in a given place or area. This process is accomplished through direct or indirect channels of distribution. In the direct channel goods go directly from the manufacturer to the consumer. In the direct channel goods go directly from the manufacturer to the consumer. In the indirect channels the goods leave the manufacturer and go to a middleman or middlemen, and finally to the consumer.
2. Distribute the handout sheet.
3. Use transparency G 25 to explain the marketing channels of distribution. (The master for the transparency is page 2.)

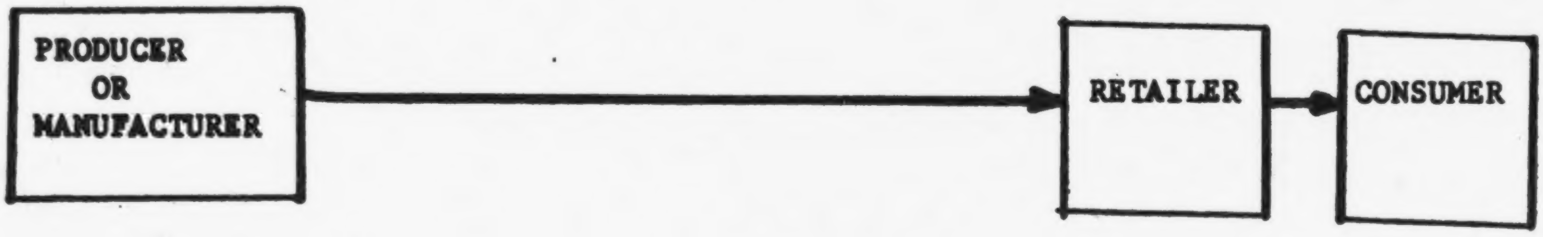
DIRECT AND INDIRECT CHANNELS OF DISTRIBUTION

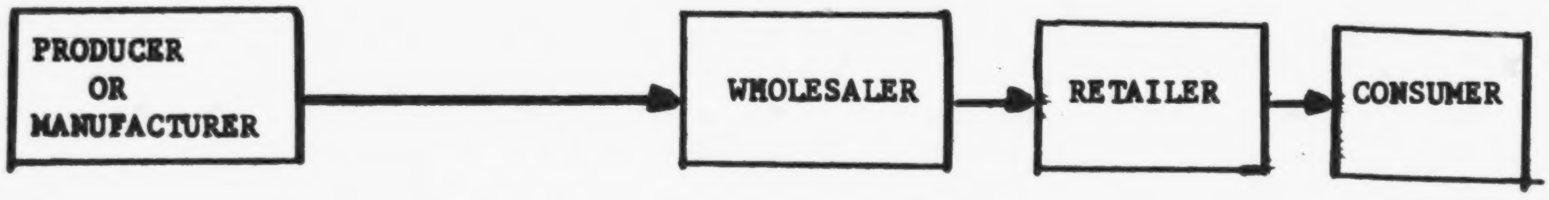
DIRECT CHANNELS

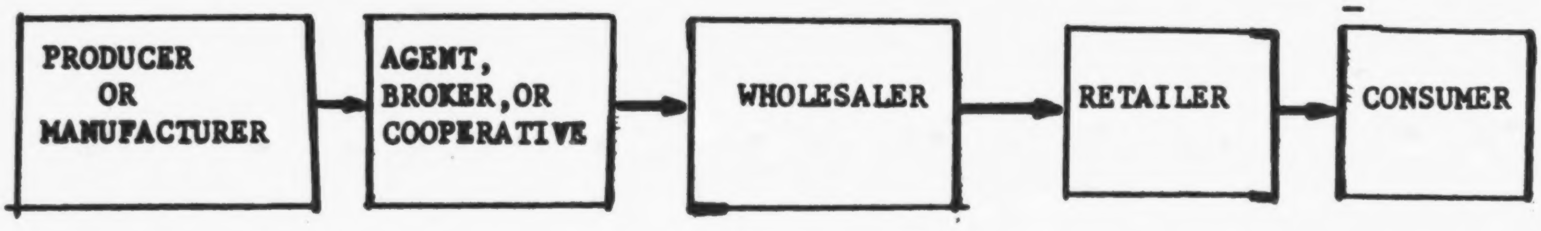

PRODUCER OR MANUFACTURER
CONSUMER


PRODUCER OR MANUFACTURER
MANUFACTURER'S RETAIL OUTLET
CONSUMER

INDIRECT CHANNELS


PRODUCER OR MANUFACTURER
RETAILER
CONSUMER


PRODUCER OR MANUFACTURER
WHOLESALER
RETAILER
CONSUMER


PRODUCER OR MANUFACTURER
AGENT, BROKER, OR COOPERATIVE
WHOLESALER
RETAILER
CONSUMER

HANDOUT SHEET
(for the student)

The Retailer

Retailers are merchant middlemen who sell to ultimate consumers. They receive their goods by purchasing for manufacturers and wholesalers. They reach consumers through stores, by mail, by house-to-house selling, and vending machines.

The primary functions undertaken by most retailers include: buying and selling, storing, dividing, packing, pricing, and delivering. In addition, there are the facilitating functions of financing (extending credit), standardizing and grading, risk-taking, and providing market information.

The Wholesaler

Wholesalers are sometime called functional and merchant middlemen. The merchant middlemen are those who buy goods for the purpose of resale, and functional middlemen are those who assist in performing the marketing functions. Wholesalers purchase goods from manufacturers and sell them to retailers, industrial users, and sometime to the ultimate consumer. Their primary functions undertaken are almost identical to the retailer.

The Broker

A broker is a functional middleman. His principal service is to bring buyer and seller together. An example is the real-estate salesman. It may be anyone in the indirect channel of distribution. They assume no title, risk, or finance for clients or goods.

Post test:

1. Write the difference between direct and indirect channels of marketing goods.

   ____

   ____

   ____

2. What is the major responsibility of a broker?

   ____

   ____

3. Most retailers purchase their goods from ______________ or ______________ and sell the goods to ______________.

4. Is the wholesaler considered a middleman in marketing distribution?

   ________ yes ________ no

5. Do wholesalers produce goods?

   ________ yes ________ no

TEACHER PACKAGE

DISTRIBUTION

MARKETING FUNCTIONS

OBJECTIVE:

The student will list at least one function of each of the following departments:

(1) Merchandising, (2) Buying, (3) Selling, (4) Transporting and Storing (5) Standardizing and Grading (6) Financing (7) Risk Managing, and (8) Securing Market Information.

ACTIVITY:

1. Introduce the material to the student. Recommend information to be used.

Purpose and Types of Market Functions

The main purpose of marketing functions are to satisfy market demands. Marketing receives these demands from the producer and the consumer. The kinds and number of functions vary with the type of product and the custom of the trade. In most business systems there are nine basic functions-merchandising, buying, selling, transporting, storing, standarization and grading, financing, risk managing, and securing market information.

There are many subdivisions of these major functions. For example, the functions of storing or standardization and grading might include assembling, dividing, and packing. Selling may include transfer of title to product, as well as the transfer of physical goods or service.

2. Pass out the handout sheets to the students.

3. Discuss each marketing function with the class.

Postest:

Choose any six of the functions and write at least one responsibility of each.

1. Merchandising - The purpose of merchanding is to analyze the market and the product to be sold, and decide on the best combination of resources and methods to maximize sales. It is essentially the function that assures the right product, at the right time, at the right place, at the right price, with the right amount of goods.

2. Buying - This function requires the selection of goods to be sold, or to be used in the business, on the basis of price, service rendered by the seller, plus the quality of the product. To obtain the best combination of price, service, and quality, specifications are drawn up, suppliers are contacted, negotiations are undertaken, purchase orders are prepared, and the goods are received and inspected. A buyer should be skilled in analyzing market demands as well as in buying supplies.

3. Selling - It's primary objective in marketing is to sell goods or services. Sales are the source of income required to cover cost and to yield a profit. After the goods have been produced, the saleman has to find a buyer and sell the goods.

4. Standarization and Grading - These are based upon predetermined standards which are defined as established measures covering the extent, quality, or quantity of a product.
   Standarization is the application of standards, whether in manufacturing, agriculture, or the extractive industries. It promotes uniformity of products so that buyers and sellers can act with confidence in the goods exchanged. Standarization makes "sale by description" possible, that is, by letter, wire, or telephone rather than by delivery of the product for inspection.
   Grading is the process of separating or inspecting products according to established specifications. It increases the efficiency of marketing; it also enhances the utility of products for consumers.

5. Financing - This function in marketing involves the use of capital to finance the marketing agencies in their various activities, plus the financing of goods moving into and through the marketing channels. The firm's own capital may be adequate, but credit is widely used. In most cases the manufacturer sells to the wholesaler on credit. In turn,, the wholesaler grants credit to the retailer. The retailer then carries his customers on a charge account or a time-payment plan. When the consumer pays his bill on account, the reverse flow of debt liquidation takes place.

6. Risk Managing- There are changes of loss in marketing as in other fields of business. The three major risks are the possibility of: (1) Physical loss of goods (2) Economic loss of value in goods, (3) and credit losses.

Fire, flood, and theft are common types of physical risk. Decline in price or market demand and obsolescence of goods contribute to loss of value. Nonpayment on accounts receivable causes credit losses. Most physical and credit loss can be covered by insurance. Actual loss is only shifted, however, because the manager must then purchase the insurance policies. The best method to minimize risk is to have a competent marketing management.

7. Securing Market Information - This is a mark of good management. Managers use statistical information from the government, private research organizations, trade associations, news services, organized exchanges, and marketing agencies. With such information, losses can be avoided more readily in the purchase of inventory in setting prices, in forecasting market demands, and in keeping pace with competition.

8. Transporting and Storing - These are often closely related. Goods held in stock for sale by the manufacturer or middlemen must be moved from storage into the channels of distribution. Reservoirs of goods must be available in strategic locations, such as wheat Minneapolis for flour milling, and consumer goods in all major retail centers.
Transportation provides the means of moving goods from sources of supply to the place where they are wanted when they are wanted. The facilities used to transport these goods are railroads, motor trucks, airplanes, ships, and pipelines.
Storage is provided to hold the goods at a location until the manufacturer, or middlemen or consumer has a need for them. Storage is used by the manufacturer, the wholesaler, and the retailer

FOR THE STUDENT

DISTRIBUTION

TYPES OF MARKETABLE GOODS

OBJECTIVE:

You will do the following:

1. State the three basic groups into which all marketable goods can be categorized.
2. Identify certain goods, and state into which category they should be grouped.

ACTIVITY:

1. Read the information on page two carefully.
2. Take a sheet of paper and divide it equally into three columns. The heading for the first column should be industrial goods; second column, commercial goods; and third column, consumer goods.
3. Turn to page three and look at the list of goods. Group each good into one of the three categories.
4. Name one retail store in your community, that markets all three of the basic typesof goods.
5. Turn your answer sheet into the instructor.

INFORMATION ABOUT THE TYPES OF MARKETABLE GOODS

Manufacturers and producers make and produce many types of goods for use. The marketing enterprise has grouped all goods on the market into three basic groups: industrial goods, commerical goods, and consumer goods.

Industrial Goods - Goods destined for use by industry in the production of commercial goods, consumer goods, or other industrial goods. Examples are tools, raw materials, machinery, fabricated materials, and supplies. The immediate destination of the good determines its characterization. For instance. in one case and automobile tire may be grouped as an industrial good and in another case it maybe grouped as a consumer good. If the tire is slated for shipment to an automobile factory, there to become a part of the assembly of an automobile, it is an industrial good. But if it is sent to a tire dealer to be sold to a car owner, it's a consumer good.

Commerical Goods - These goods consist of many items that are not intended for use in the fabrication of other goods but which are destined for use in business in the form in which they are purchased. Examples are office machines and equipment. cash registers, fixtures, filing cabinets, and office furniture.

Consumer Goods - Goods destined for use by the individual ultimate consumer in such form that they can be used by him without further commercial processing. These goods may be further classified as (1) convenience goods, (2) shopping goods, and (3) specialty goods.

(1) Convenience Goods - These are goods that consumers purchase conveniently, immediately, and with a minimum of effort. They include such items as cigarettes, candies, newspapers, and many grocery products. The goods are relatively low in price and are usually branded; they are found in most types of stores.

(2) Shopping Goods - These are goods in the purchase of which the consumer desires to compare the offerings of competing stores on various bases, such as price, quality, and style. These types of goods are usually found in the department stores, such as wohem's clothing, furniture. dress, and millinery. The buyer is more concerned with materials, style, and design, than with brand name. These goods are bought more frequently by women than men and are found in the medium-price range.

(3) Specialty Goods - The goods are always branded. The consumer is willing to go to considerable effort to secure his brand preference. Examples are cars, men's clothing and shoes, jewelry, and appliances. These goods are bought more frequently by men than women.

CLASSIFY THESE GOODS INTO THE THREE CATEGORIES

Iron Ore

Men's Hats

Books (Encyclopedia)

Shoes

Limestone

Engine Lathe

3000 Tons of Plastic

30 Filing Cabinets

400 - Tables

600 Light-bulbs

2-Bicycle Tires

A Bed

1970 - Ford

A Refrigerator

A Gun

Hair-comb

TEACHER PACKAGE

DISTRIBUTION

MIDDLEMEN METHODS OF DETERMINING PRICES OF GOODS

Objective:

The student will do the following:

1. List atleast one of the basic methods used by sellers in setting their price.
2. Discuss orally the differences between cost of goods, gross margin, markup, operating expenses, profit, and selling price.
3. Tell others who determine the prices of goods.

Prereqursite:

Refer to package G-29 for a definition of middleman.

Activity:

1. Discuss pricing as it relates to marketing. Recommended information to be used:

Factors Which Help Sellers in Determining Prices

In the majority of instances, prices are established in business by sellers, who take into account a number of factors. Three basic methods are followed by sellers in setting their prices. These methods are as follows:

(1) With known unit cost of production, distribution, and overhead the seller adds a desired profit and compares the resultant figure with the price of competition. Depending upon the nature of the product and the rigor of its competition, seller prices his product below or above his competitors' price.

When a seller, usually a producer, establishes his price at a predetermined level, he is following a policy of adminstered prices. This price is usually used by competitors so that price competition will be de-emphasized in his appeal for sales. The marketing authorities refer to administeredprices as "judgement prices."

(2) Sometime a seller feels that competition has set the price below the price at which the product should be sold. When this happens, the seller works backwards from that price to the permissible unit cost and then determines whether or not the available margin is sufficient to enable him to operate profitably. When the seller determines no profit in selling a product, in most cases he drop the product, or asks his suppliers to lower their cost to a level that will permit him to make a profit.

(3) Many times the seller buys one product, and must divide it into several prices. Each piece may sell for a different price. The seller must determine the price for each piece so that he can receive more money than he paid for the initial product, and make a profit. For example, a butcher buys a side of beef at so many cents per pound; but in pricing the different cuts, such as sirloin and round, he takes into account their relative appeal to consumers and prices them accordingly. The seller set his price per cut so as to realize a profit on each side of beef that he handles.

2. Pass out the handout sheet to the students.
3. Discuss with the students cost-plus pricing.
4. Discuss with the students backward pricing.

Post Test:

1. In most businesses who determines the price of the product ?
2. What do the following terms mean— cost of goods, markup, operating expenses, and profit.

HANDOUT SHEET

Cost-Plus Pricing

In cost- plus pricing the seller determines the price of a product by adding the cost of the goods plus the markup. For better understanding remember the following:

1. Cost of Good- is the price the present owner pays for the product. The equation is: cost of good = selling price —markup.
2. Operating Expenses- is a part of markup. It is the price charged to the consumer by the owner for producing the product, or handling, or storing, etc. The equation is: operating expenses = selling price — profit — cost of good.
3. Profit- is the amount of money on hand after deducting cost of goods and operating expenses. The equation is: profit = selling price — cost of goods — operating expenses.
4. Gross Margin or Markup- is the price charged to the consumer by the seller for operating expenses plus profit. The equation is: markup = selling price — cost of good.
5. Selling Price = cost of goods + markup

The illustration below will give you some idea about the work of sellers. The product to be sold is a table- lamp. These are the channels the product must go through - manufacturer, wholesaler, retailer, and consumer. The seller figured the following:

CHANNELS:	COST OF GOOD	+	OPERATING EXPENSES (40% of cost)	+	PROFIT (10% of cost)	=	SELLING PRICE
Manufacturer	$40.00	+	$16.00	+	$4.00	=	$60.00
Wholesaler	$60.00	+	$24.00	+	$6.00	=	$90.00
Retailer	$90.00	+	$45.00	+	$9.00	=	$144.00
Consumer	$144.00						

Backward Pricing

In backward pricing, the markup is adjusted to the difference between the selling price in the market, set by competing firms, and the cost of the good to the seller. When the seller sees no profit margin in resulting markup, he is forced to abandon the product, or, if possible, adjust his cost downward or raise his price above that charged by competitors to insure a profit. Sometime the seller accepts the competitive price in the market and sells at a loss for a period until cost can be reduced or the price increased.

The seller starts with the price of the product already established in the market by competitors and then subtracts his various cost from the price to find out if he will obtain a net profit or a net loss under the existing price. The seller uses a formula- present competitors price = cost they pay for the product plus markup. This procedure is in contrast to the cost-plus method in which the seller starts with his cost and then adds an amount for profit. In backward or cost-plus pricing the competitors price is the major issue for sellers.

FOR THE STUDENT

DISTRIBUTION

MIDDLEMAN BUYING AND SELLING POLICIES

Objective:

You will state atleast four buying and selling policies used by business firms.

Prerecursite:

Completion of package G-28.

Activity:

1. Read the related information on pages 3 and 4.
2. In the chart below rate the goods in each column according to the following:
   A. Column One: Write the dominant method you thing is being used by most retailers to sell the product. Use L. P. (low prices) and H. P. (high prices).
   B. Column Two: Write "yes" if you think the price of the product has been stable for the past two years and "no" if it has not.
   C. Column Three: Write "yes" if the dominant pricing method is odd and "no" if it is not.
   D. Column Four: Write "yes", if you think you can purchase the product at a discount price and "no" if not.

Note: You must be able to defend each answer by telling, if asked, why you chose one answer over another.

COLUMNS

NAME OF THE PRODUCT	LOW or HIGH PRICES	STABLE PRICE	ODD PRICE	DISCOUNT PRICE
A new 19___ Ford Car				
A new Home				
Mens' Shoes (Name Brand)				
Philco (color) Television Set				
A case of Coca Cola				
Chewing Gum (two packages)				
The daily newpaper				
Grocery in a discount market				
Your monthly gas bill				

3. Tabulate the class answers.
4. Put the tabulated answers on a chart and give it to the instructor.

Post Test:

On your paper answer the following:

1. Name atleast four buying and selling policies used by business firms.
2. Explain the difference between stable and odd prices.

RELATED INFORMATION FOR BUYING AND SELLING POLICIES G-29

Buying and Selling Characteristics

Most market middlemen use one or more of the following methods in buying and selling goods. These price methods are: low, high, stable, odd, delivered, varying, and discount.

1. Low Prices- The goods are priced at the lowest price consistent with the company's operating expense and profit philosophy. This method is used mostly by discount houses.
2. High Prices- When the goods are priced above normal or the markup is above the average price of competitors. This is the policy embraced by numerous department and specialty stores, dealers in fancy groceries, and manufacturers of quality goods. In some instances these prices represent better merchandise; in others they reflect a desire to secure a higer profit.
3. Stable Prices- Once the price has been established it remains constant for long period of time regardless of the fluctuation of the cost of goods or of the expenses of the sellers involved. Examples are chewing gum. coca cola. and where the retail price is printed on the package.
4. Odd Prices- This method is used by many business firms. They use it because it seems to be more appealing to the prespective buyer than even prices. The idea that $2.95 is more appealing than $3.00 and that you can sell more goods at 9 cents than at 10 cents. The underlying theory of this policy is that $1.93 makes the prespective buyer think of $1.00 plus some cents, rather than a price slightly less than $2.00.
5. Delivered Prices- It means that the price quoted to the seller is free on board (f.o.b.) destination. In most cases this price varies according to distances. For example a car produced in Michigan and sold in Chio and New York; the price of the car , in most cases, would be more in New York than in Ohio because of delivery price.
6. Varying Prices- This is the price given by many wholesalers to the retailer. The price from time to time is reduced in favor of particular purchasers. This flexibility of price come about because of superior bargaining skills of certain buyers or because of the size of their purchases. The seller calls this a concession or discount policy.
7. Discount Policy- A discount is a reduction in price made by a seller to a buyer on one or more of the following bases.

   A. Trade discount, which is based on the list price of the product. Recognizes the different functions performed by wholesalers and retailers. For example, the list price $45. and the trade discount is 33 1/3 %, the wholesaler's price to the retailer is $30.

   B. Quantity discount is offered by some sellers as a reward to buyers who order in large quantities. It maybe cumulative or noncumulative in character. Cumulative- permits buyer to utilize two or more separate purchases in the computation of the quantities to which discount may apply, whereas the noncumulative type is applicable only in single purchases.

C. Cash discount is an inducement offered by the seller to encourage the buyer to pay his bill within a short time after the goods have been delivered. Example: The buyer may see on the invoice 2/10, which means if the bill is paid within 10 days after its date, the buyer may deduct 2 percent of the amount of the invoice.

FOR THE STUDENT

DISTRIBUTION

DETERMINING THE PRICE OF YOUR PRODUCT

Objective:

A committee of students will work together and establish the price to charge for your product.

Prereqursite:

Completion of package G-28 and G-29.

Activity:

A committee of students will work together on this package.

1. If your product is similar to a competitors product; then use the backward pricing method to determine the price of your product. The formula is: competitors price = cost of materials + operating expenses + profit.
   A. Things you must know and do in order to solve the equation.
      (1) Know the competitor's price.
      (2) Be able to figure out the cost of materials, operating expenses, and profit.
2. If your product is quite different from any competitor that you know of, or if you cannot find out competitor's price; then use the cost-plus pricing method to determine the price of your product. The formula is: cost of materials + operating expenses + profit = selling price.
3. Have the price agreed upon by the committee and approved by the entire corporation.

FOR THE STUDENT

DISTRIBUTION

DEVELOPING AN ORDER BLANK

Objective:

You will design an order blank to use in taking orders for your product.

Activity:

1. A committee of two or three students should work together on this package.

2. An order blank should have some or all of the following:

   A. The name and address of the producer.
   B. Name of the product being produced.
   C. Give one or more uses of the product.
   D. The date the order was taken.
   E. The date of expected delivery.
   F. The name and address of the customer.
   G. The customer's order number.
   H. The name or title of the person taking the order from the customer.
   J. The price of the product.
   K. A place for the customer to sign upon receiving the product.

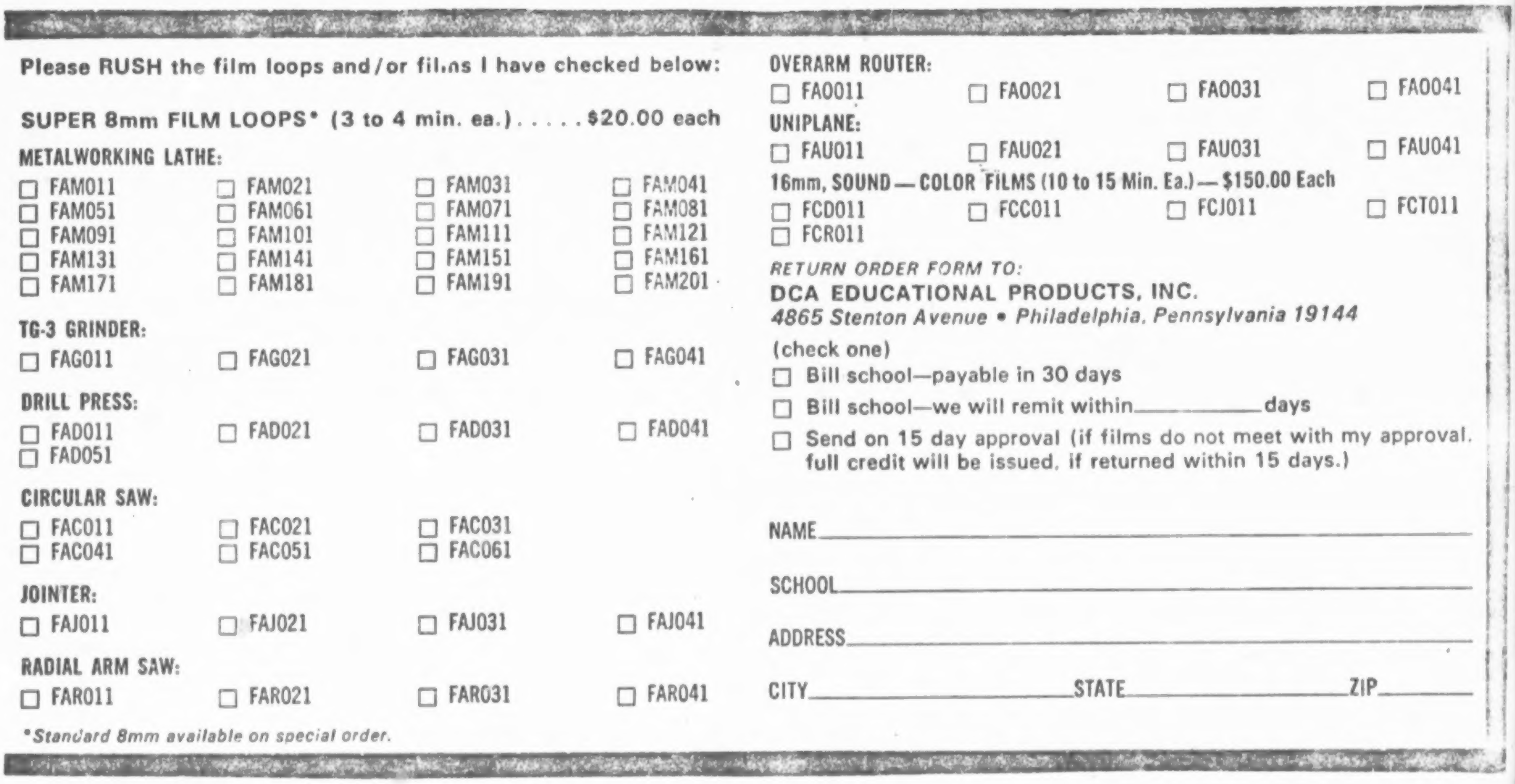
3. Use the above information (A-K) plus the sample order blanks, found on pages two and three, as a guide. Make up a tentative order blank to sell your product.

4. Have the order blank approved by the instructor.

5. Layout the order blank in the approved form and let the instructor check it again.

6. Give it to the recorder to be typed.

SAMPLE ORDER BLANKS



Please RUSH the film loops and/or films I have checked below:

SUPER 8mm FILM LOOPS* (3 to 4 min. ea.) . . . . . $20.00 each

METALWORKING LATHE:

☐ FAM011 ☐ FAM021 ☐ FAM031 ☐ FAM041
☐ FAM051 ☐ FAM061 ☐ FAM071 ☐ FAM081
☐ FAM091 ☐ FAM101 ☐ FAM111 ☐ FAM121
☐ FAM131 ☐ FAM141 ☐ FAM151 ☐ FAM161
☐ FAM171 ☐ FAM181 ☐ FAM191 ☐ FAM201

TG-3 GRINDER:

☐ FAG011 ☐ FAG021 ☐ FAG031 ☐ FAG041

DRILL PRESS:

☐ FAD011 ☐ FAD021 ☐ FAD031 ☐ FAD041
☐ FAD051

CIRCULAR SAW:

☐ FAC011 ☐ FAC021 ☐ FAC031
☐ FAC041 ☐ FAC051 ☐ FAC061

JOINTER:

☐ FAJ011 ☐ FAJ021 ☐ FAJ031 ☐ FAJ041

RADIAL ARM SAW:

☐ FAR011 ☐ FAR021 ☐ FAR031 ☐ FAR041

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☐ FA0011 ☐ FA0021 ☐ FA0031 ☐ FA0041

UNIPLANE:

☐ FAU011 ☐ FAU021 ☐ FAU031 ☐ FAU041

16mm, SOUND — COLOR FILMS (10 to 15 Min. Ea.) — $150.00 Each

☐ FCD011 ☐ FCC011 ☐ FCJ011 ☐ FCT011
☐ FCR011

RETURN ORDER FORM TO:
DCA EDUCATIONAL PRODUCTS, INC.
4865 Stenton Avenue • Philadelphia, Pennsylvania 19144

(check one)

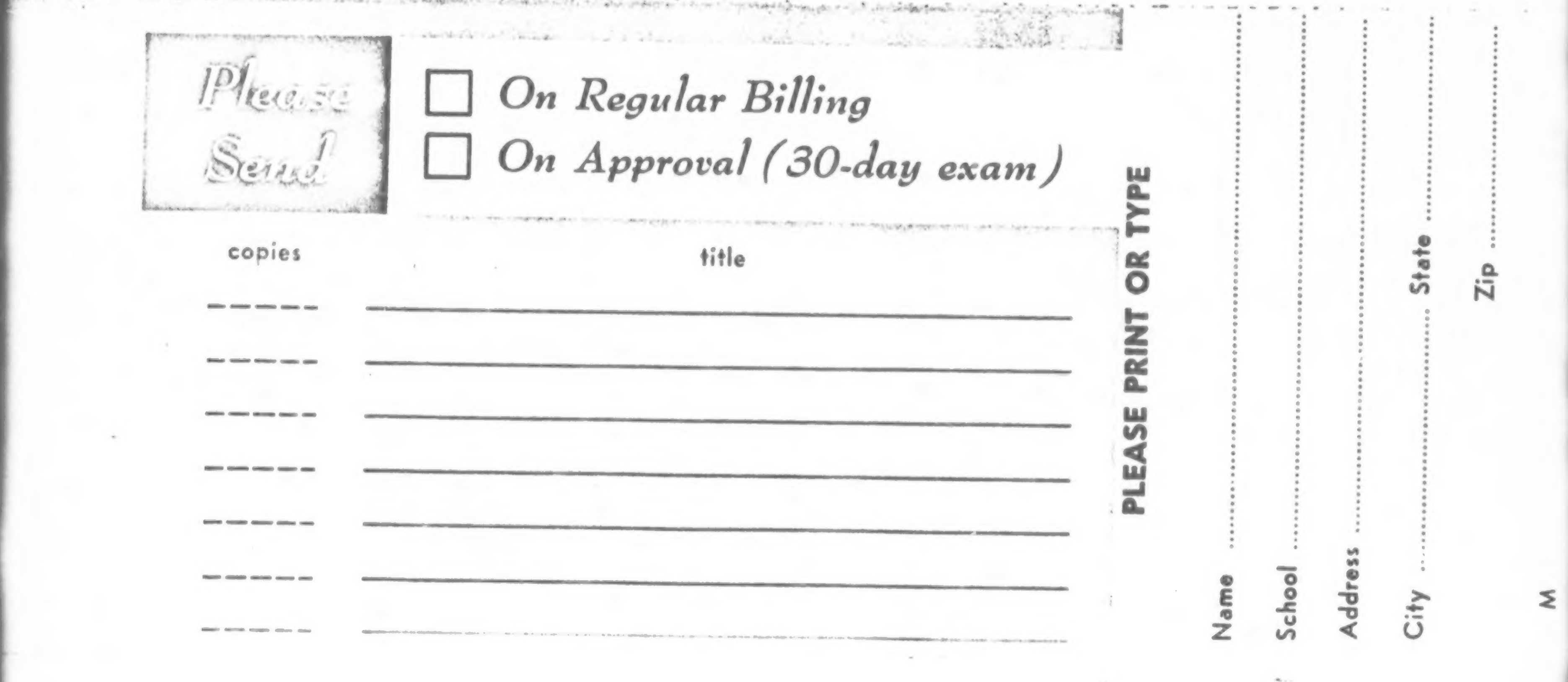
☐ Bill school—payable in 30 days
☐ Bill school—we will remit within__________days
☐ Send on 15 day approval (if films do not meet with my approval, full credit will be issued, if returned within 15 days.)

NAME______________________________

SCHOOL______________________________

ADDRESS______________________________

CITY____________STATE____________ZIP______



Please Send

☐ *On Regular Billing*
☐ *On Approval (30-day exam)*

copies	title

PLEASE PRINT OR TYPE

Name ....

School ....

Address ....

City .... State

Zip ....

M

G 32

1969

ORDER BLANK

BRODHEAD - GARRETT CO.

4560 EAST 71st STREET
CLEVELAND, OHIO 44105

DATE ....

BILL TO ....
ADDRESS ....
CITY and STATE ....

SHIP TO ....
ADDRESS ....
CITY and STATE ....

CUSTOMER ORDER No. ....

ORDERED BY .... TITLE ....

QUAN.	UNIT	CAT. No.	DESCRIPTION AND SIZE	PRICE	TOTAL	

Brodhead-Garrett pays shipping charges on all orders over $50.00. TOTAL

Subject to acceptance at the Home Office of the Company at Cleveland, Ohio

(Over)

FOR THE STUDENT

No. G-33

DISTRIBUTION

FILLING OUT ORDER FORMS

Objective:

You will fill out an order form for your product, getting all required information, and making no errors.

Prerequisite:

Completion of package G-32

Activity:

THE COMMITTEE THAT DEVELOPED THE ORDER BLANK WILL SUPERVISE THE ACTIVITIES.

1. Make a sketch of your order blank on the chalkboard or on a transparency.
2. You are now ready to explain each item on the order blank to the rest of the class.
3. Give each student an order blank.
4. Two committee members will role-play taking and filling out an order blank. One becomes a salesman and the other a prospective customer. The salesman will take the order from the prospective customer. As the prospective customer gives information to the salesman, he will fill it into the order form.
5. Let the class ask questions about any item on the order blank.
6. Ask half of the class to think of themselves as prospective customers of the product we are producing and the other half as salesmen of the product.
7. Have the salesmen take orders from the prospective customers.
8. Have the class reverse roles, by letting the prospective customers become salesmen and the salesmen become prospective customers. Have these groups repeat activity number seven.
9. The committee will check the order blanks filled out by the rest of the class. Each member in the class should practice filling out the order from until he can do it correctly.

FOR THE STUDENT

DISTRIBUTION

TAKING ORDERS

Objective:

You will take orders for your product.

Prerequisite:

Completion of packages G 32 and G 33.

Activity:

1. Take orders within the school and in the community.
2. When taking orders tell the perspective consumer, A) Who you are, B) The school you attend, C) What you are trying to sell, D) Show a model or a picture of the product to be sold if possible, and E) Tell him the price of the product.
3. Fill out the order blank.
4. Tell the customer when he will receive the product.
5. Each day report the number of orders you have taken to the recorder.
6. In your record book write the name and address of your customers. You will need this when delivering the product.

DISTRIBUTION

DELIVERING THE PRODUCT AND COLLECTING THE MONEY

Objective:

You will distribute your product to the consumer, and collect the money.

Prerequisite:

Completion of packages G 32, G 33, and G 34.

Activity:

1. Tell the recorder the number of orders you are to fill that day so he can record them.
2. Go to the wholesaler or retail department and have your order filled.
3. Sign your name and have the distribution department sign for each product.
4. Store these products in the proper place so you can check them out for delivery.
5. Collect the money from the consumer upon delivery of the product. NOTE: This method is called Cash On Delivery (C.O.D.).
6. Return the money to the recorder and he will give you a receipt. NOTE: Study the samples of receipts on page two. The recorder should design and print a supply of standard receipts to use.
7. Repeat steps 1-7 until all orders have been filled.

A SAMPLE RECEIPT

	THE NAME OF THE MANUFACTURER
No.________	No. ________
DATE__________19__________	RECEIVED OF________________________
To:________________________	AMOUNT________________________
For:________________________	FOR________________________
________________________	DATE______________SIGNED______________
Amt. $________________	

The blank copy

	THE NAME OF THE MANUFACTURER
	No.___8_____
No.___8_____	
DATE 3-28 1974	RECEIVED OF Gregory J. Lawson
To: Gregory J. Lawson	AMOUNT $10.00
For: Two Wall Lamps	FOR Two Wall Lamps
________________________	DATE 3-28-1974 SIGNED Robert Jones
Amt. $10.00	

The filled out copy

TEACHER PACKAGE

DISTRIBUTION

AN INTRODUCTION TO MARKET FINANCE

Objective:

You will discuss some of the needs, types of capital, and sources used in market finance.

Prereqursite:

Completion of packages G-25 and 26.

Activity:

1. Pass out the handout sheets to the class.
2. Discuss finance as it relates to marketing. Get the students involved in the discussion. One way of doing this is to let a student read the definition for every underlined term in the recommended information.

Recommended Information

Is this a true saying, "It takes money to make money" ? Business men today accept this saying as a partial truth. Their saying for today is; "If you have money, and it is properly managed, you will make money".

What are the major responibilities of the market finance department ? They have to: (1) obtain an adecuate supply of capital for the needs of the enterprise, (2) conserve and enhance the invested capital through sound management, and (3) generate income for the enterprise.

All business firms need capital to purchase assets and to pay expenses. These needs persist throughout the life of marketing. When a business firm decides to go into marketing; the executives invest the company's capital and borrow the rest of the capital needed from finance agencies.

When borrowing money to invest in permanent capital, it is best to use the fixed asset plan. This plan allows one to borrow, and have up to twenty years or more to pay the debt. This metdod is called long-term financing.

There are over 60 types of financial agencies, private and public, which serve the needs of our nation. The primary agencies which invest permanent capital are savings banks, trust companies, savings and loan associations, insurance companies, investment companies, and pension funds. The primary agency which invests temporary capital is commercial banks. Additional agencies which aid in temporary financing include commerical paper houses, finance companies, factors, sales finance companies, and the Small Business Adminstration. All of these finance agencies are subject to government regulation in varying degrees.

All finance institutions charge interest to the borrower for using the money. This is the way they make a profit. The amount of interest charged to borrowers varies. The interest varies according to the type of loan and the amount of time allowed to pay the debt off.

Post Test:

1. Name the three major responibilities of the market finance department.
2. What is capital funds?
3. Define finance agencies.
4. Explain the difference between long and short term borrowing.

HANDOUT SHEET

Important Terms to Remember

1. Market Finance- the activity concerned with the acquisition by an administration of capital funds in meeting the financial needs and overall objectives of the enterprise.
2. Capital- money or property owned or used in business.
3. Assets- those items needed by the market department to operate efficiently, such as- buildings, equipment, inventories, and an adequate supply of cash on hand.
4. Finance Agencies- those institutions which allow business firms to borrow money from them, such as, banks, loan companies, factors, etc.
5. Long-Term Finance- allows the borrower a long period of time to pay the debt, in some cases twenty or more years.
6. Short-Term Financing- allows the borrower from three-months to one year to pay the debt.
7. Intermediate Credit- allows the borrower from one to ten years to pay the debt. Most companies today categorize this as short-term financing.
8. Interest- the amount of profit that the lender charges the borrower. For example, if you borrow $100.00 from the lender and pay him back $110.00, the lender's interest was 10 percent.

FOR THE STUDENT

DISTRIBUTION

PREPARING FOR A FIELD TRIP TO A BANK

Objective:

The committee will do the following:

1. Make all the necessary preparations with the bank personnel and the school adminstration.
2. Explain orally to the rest of the class the topics which will be discussed with the banker.

Prerecursite:

Completion of packages G-30, G-36, C-4, C-5, and C-6.

Activity:

A committee of three to five students will work together on this package.

1. Elect a chairman and a co-chairman from within the committee.
2. Decide which bank within your community you would like to visit.
3. Develop a business letter requesting a visit to the bank. The letter should include what you would like to see and discuss while at the bank. The following are some of the items which should be in the letter:
   - A. The title of the class and grade.
   - B. The size of the class.
   - C. Tell if you would like a tour of the facilities.
   - D. A formal discussion about stocks, bonds, interest on money, and methods of financing.
   - E. What dates would the bank be able to accept the class?
4. Have the format of the letter approved by the teacher.
5. The letter should be signed by the chairman and co-chairman of the committee, and have an approval signature of your teacher, department head, and principal of the school.
6. After getting the signature of all persons, with the exception of the principal, the committee should take the letter to his office for acceptance of the idea and the approval signature.
7. Mail the letter to the President of the bank.
8. Based on the reply from the president of the bank you will do the following:
   - A. If his reply was; the class cannot visit the bank. Then write another letter asking him to send someone to your school to explain activity 3-D in this package.
   - B. If his reply was; the class can visit the bank. Then proceed with plans one through nine, on page three.
     - (1) Decide the definite date you would like to go. Have the date approved by your teacher and the principal.
     - (2) Develop a letter telling the banker what date and time he can expect the class. Follow the same procedure you did before for approval and signature.

(3) Review with the rest of class the information on the handout sheets from packages G-36, C-5, and C-6.
(4) The day you are visiting the bank make sure that everyone has a list of the handout found on page three of package G-37
(5) The day after the visit you will lead a discussion by reviewing the many things you were told by the banker.

HANDOUT SHEET

The following are some of the key questions you may wish to discuss with the banker.

1. During the tour will you explain some of the responibilities of such as the vice-president, cashier, secretary, bookkeeper, etc?
2. Explain long and short-term financing as it applies to your banking operation.
3. Explain the differences between common and perferred stock. Also how one buys and receive dividends for each type of stock.
4. Explain the differences between stocks and bonds as they relate to the purchaser and the seller.
5. Is this bank primarily a long or short- term financing agency?
6. Explain to us how interest is figured for long and short-term loans. Using a large coroperation as an example, a small business, and a individual.
7. What are some of the government regulations which you are forced to follow?
8. Explain the steps to follow in acquiring a loan for long and short-term.
9. As a banker is it very important that you keep up-to-date with the financial news? If so, tell us why.

DISTRIBUTION

THE FUNCTIONS OF THE COPY DEPARTMENT

Objective:

As head of the copy department you will write the copy for an ad and submit it to the head of the advertising department.

Activity:

1. Read Package G-2 and pay special attention to the information regarding the copy department.

2. Most advertising copy is made up of several sections which are listed as the headline, the illustration, body or copy, and the slogan.

3. The headline is the most important section of the copy. It is the device which attracts the attention of the customer. This is very important as it will determine whether or not the person will read the rest of the ad. The type should be larger than the rest of the ad, and it must be short and to the point. Remember it must capture the customer's interest.

4. You will not be responsible for the illustration, but you must work with the person who is doing the illustrations, to decide on the best size and type of pictures to use.

5. The body or copy is the section that must sell the product. This is where the printed word must be used in the appropriate manner to do its job. It must also create an interest in the product by the consumer. It must tell the consumer what the product can do for him. It must also tell the consumer the price and where to purchase the item. The consumer must feel that he will benefit from owning this product.

6. Slogan, Trademarks, and Seals. These appear in the advertizement as the symbol of the company. As the Rock of Gibraltar stands for the Prudential Insurance Company, a school emblem or motto may be the slogan for your product. It may help in identifying your school with the ad.

7. Writing advertizing has been said to be based on the AIDA theory.

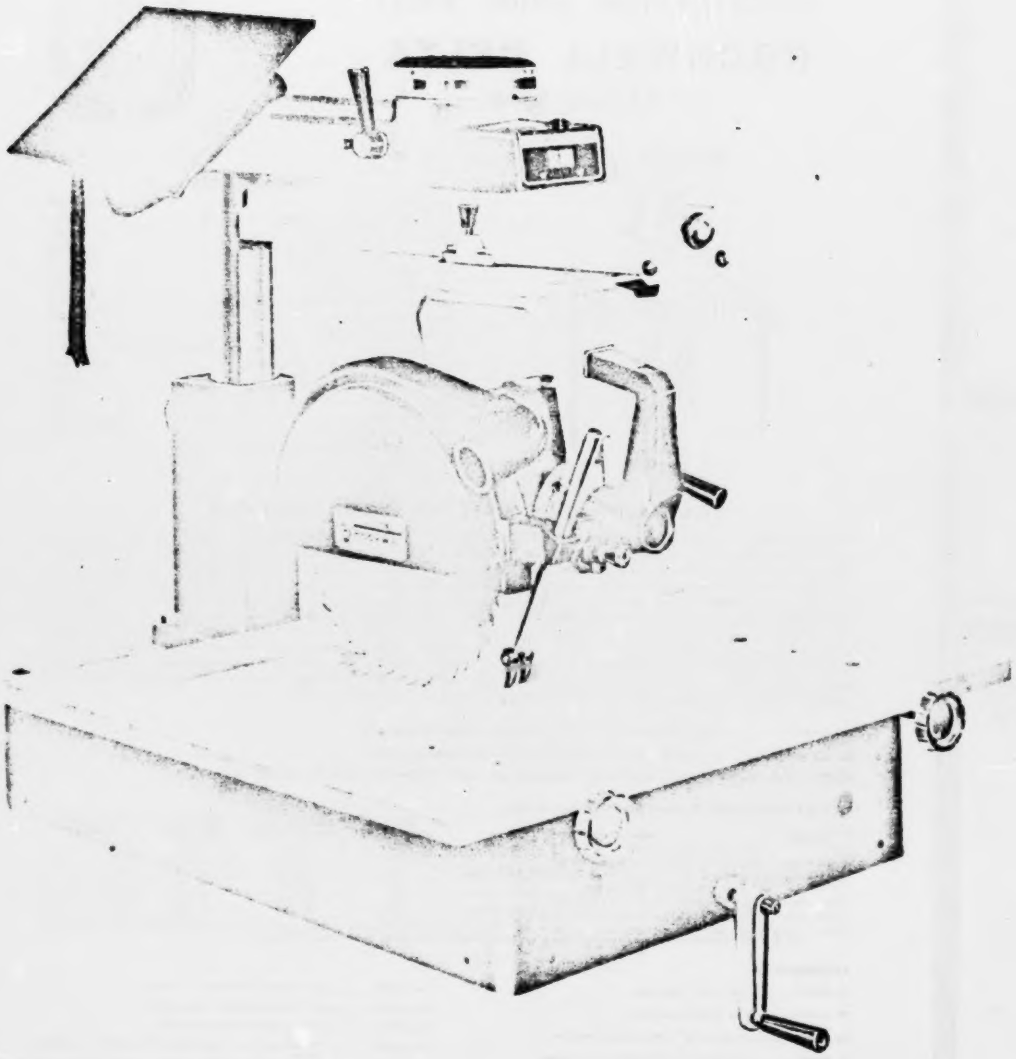
   A--Get their ATTENTION
   I--Create an INTEREST
   D--Effect a DESIRE
   A--Get some ACTION

   This is the main thing you want your copy to do. The headline should get their attention, and create an interest. The body should create the desire for the product, and sell the product.

Post Test:

Write the copy for the ad using the above procedures, and present it to the head of the advertising section for his approval. See the sample ad on the next page for some ideas. Look at newspaper and magazine ads for other ideas.

HANG YOUR HAT ON THIS ONE



Day after day, builders and industrial users across the United States and Canada rely on this dependable Rockwell Delta 12" Radial Saw. You can, too!

Here's why: 1. Double overarm for greater left-hand miter capacity. **2.** "Up-front" elevating crank. **3.** "Up-front" miter index control. **4.** "Up-front" eye level miter scale. **5.** "Up-front" track lock. **6.** Extra large, easy-to-read bevel scale. **7.** Large, convenient fence lock knobs. **8.** Convenient, safe on-off switch. **9.** Adjust-O-Matic column-base. **10.** Preferred jack screw table adjustment.

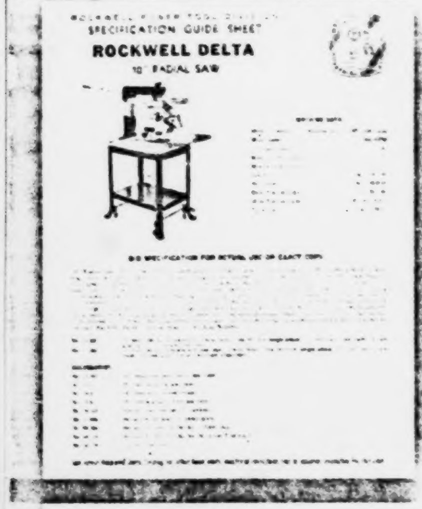
See a **"Proof-by-Performance"** demonstration at your local Rockwell Delta Dealer.

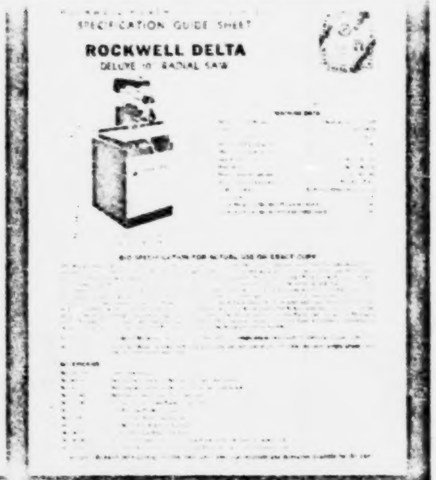
Rockwell Has More Ways to Help You Teach!

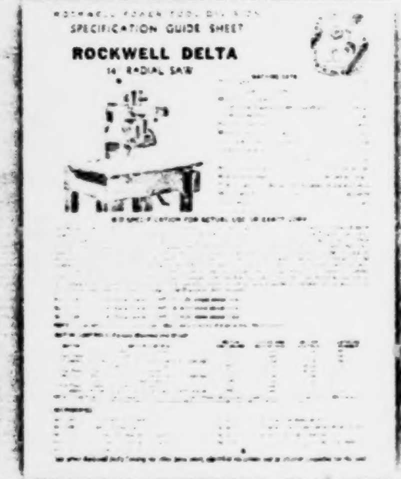
POWER TOOL DIVISION
Rockwell
MANUFACTURING COMPANY
Pittsburgh, Pennsylvania 15208
Return Postage Guaranteed

BULK RATE
U. S. POSTAGE
PAID
PITTSBURGH, PA.
PERMIT NO. 1501

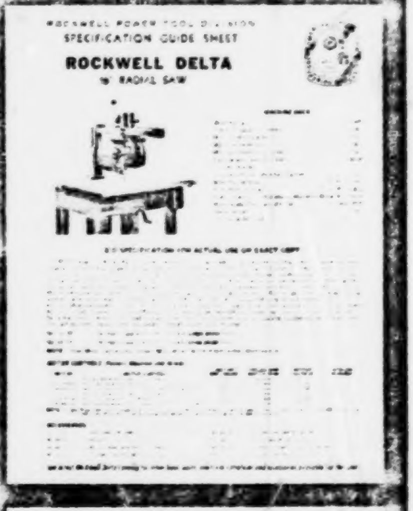
Rockwell has more ways to saw

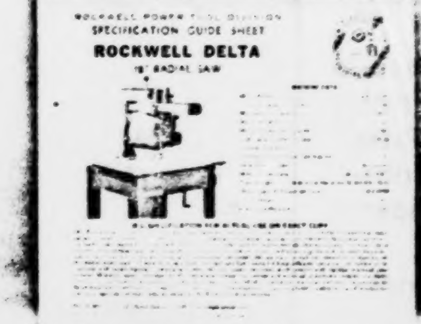

SPECIFICATION GUIDE SHEET
ROCKWELL DELTA
10" RADIAL SAW


SPECIFICATION GUIDE SHEET
ROCKWELL DELTA
DELUXE 10" RADIAL SAW


ROCKWELL POWER TOOL DIVISION
SPECIFICATION GUIDE SHEET
ROCKWELL DELTA
14" RADIAL SAW

ORDER THESE SPECIFICATION GUIDE SHEETS TODAY!


ROCKWELL POWER TOOL DIVISION
SPECIFICATION GUIDE SHEET
ROCKWELL DELTA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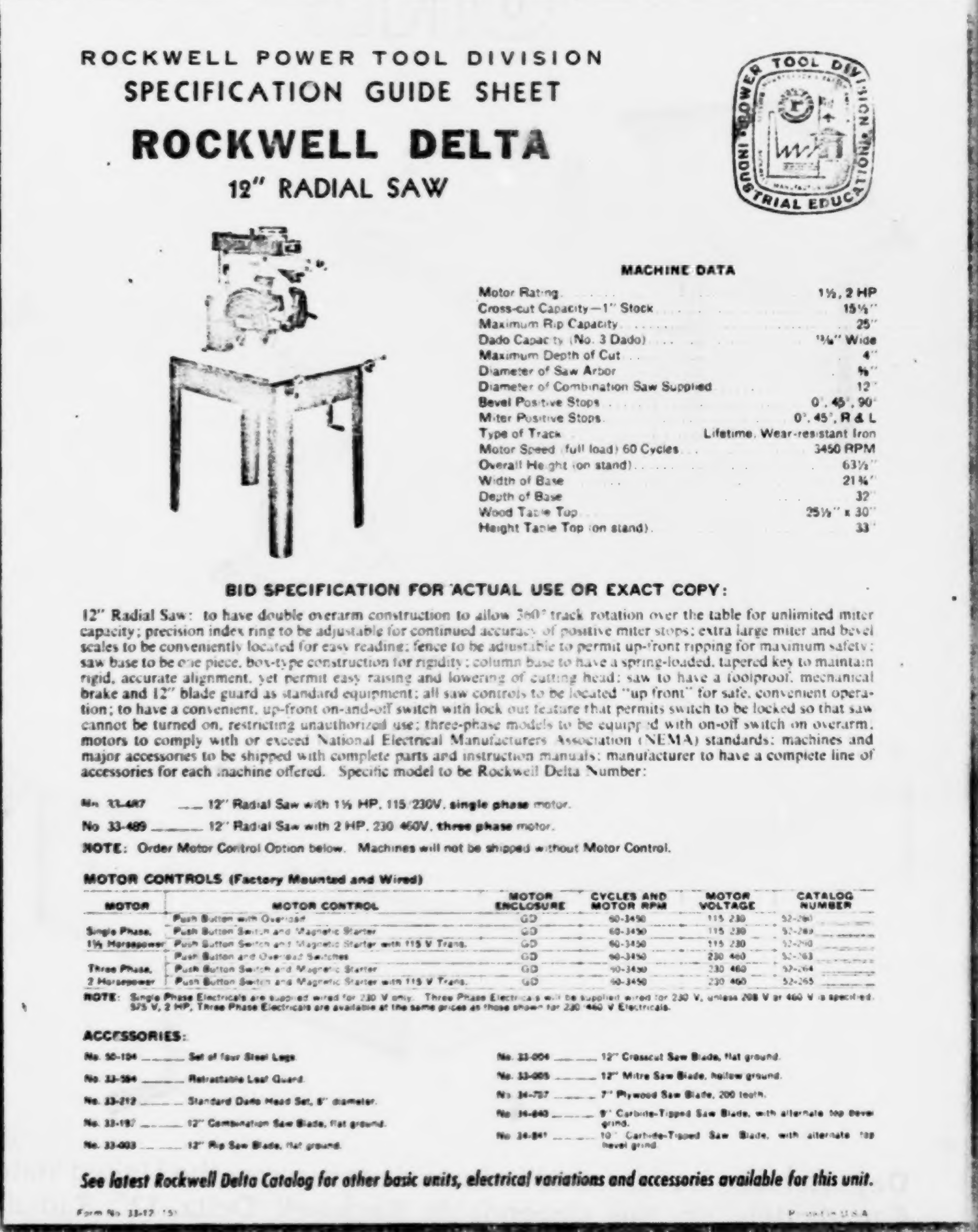
SPECIFICATION GUIDE SHEET
ROCKWELL DELTA


ROCKWELL POWER TOOL DIVISION
SPECIFICATION GUIDE SHEET

ROCKWELL DELTA

12" RADIAL SAW

POWER TOOL DIVISION
INDUSTRIAL EDUCATION

MACHINE DATA

Motor Rating	1½, 2 HP
Cross-cut Capacity—1" Stock	15½"
Maximum Rip Capacity	25"
Dado Capacity (No. 3 Dado)	13/16" Wide
Maximum Depth of Cut	4"
Diameter of Saw Arbor	⅝"
Diameter of Combination Saw Supplied	12"
Bevel Positive Stops	0°, 45°, 90°
Miter Positive Stops	0°, 45°, R & L
Type of Track	Lifetime, Wear-resistant Iron
Motor Speed (full load) 60 Cycles	3450 RPM
Overall Height (on stand)	63½"
Width of Base	21¾"
Depth of Base	32"
Wood Table Top	25½" x 30"
Height Table Top (on stand)	33"

BID SPECIFICATION FOR ACTUAL USE OR EXACT COPY:

12" Radial Saw: to have double overarm construction to allow 360° track rotation over the table for unlimited miter capacity; precision index ring to be adjustable for continued accuracy of positive miter stops; extra large miter and bevel scales to be conveniently located for easy reading; fence to be adjustable to permit up-front ripping for maximum safety; saw base to be one piece, box-type construction for rigidity; column base to have a spring-loaded, tapered key to maintain rigid, accurate alignment, yet permit easy raising and lowering of cutting head; saw to have a foolproof, mechanical brake and 12" blade guard as standard equipment; all saw controls to be located "up front" for safe, convenient operation; to have a convenient, up-front on-and-off switch with lock out feature that permits switch to be locked so that saw cannot be turned on, restricting unauthorized use; three-phase models to be equipped with on-off switch on overarm; motors to comply with or exceed National Electrical Manufacturers Association (NEMA) standards; machines and major accessories to be shipped with complete parts and instruction manuals; manufacturer to have a complete line of accessories for each machine offered. Specific model to be Rockwell Delta Number:

No. 33-487 ______ 12" Radial Saw with 1½ HP, 115/230V, **single phase** motor.
No. 33-489 ______ 12" Radial Saw with 2 HP, 230/460V, **three phase** motor.

NOTE: Order Motor Control Option below. Machines will not be shipped without Motor Control.

MOTOR CONTROLS (Factory Mounted and Wired)

MOTOR	MOTOR CONTROL	MOTOR ENCLOSURE	CYCLES AND MOTOR RPM	MOTOR VOLTAGE	CATALOG NUMBER
Single Phase, 1½ Horsepower	Push Button with Overload	GD	60-3450	115/230	52-261
	Push Button Switch and Magnetic Starter	GD	60-3450	115/230	52-262
	Push Button Switch and Magnetic Starter with 115 V Trans.	GD	60-3450	115/230	52-260
Three Phase, 2 Horsepower	Push Button and Overload Switches	GD	60-3450	230/460	52-263
	Push Button Switch and Magnetic Starter	GD	60-3450	230/460	52-264
	Push Button Switch and Magnetic Starter with 115 V Trans.	GD	60-3450	230/460	52-265

NOTE: Single Phase Electricals are supplied wired for 230 V only. Three Phase Electricals will be supplied wired for 230 V, unless 208 V or 460 V is specified. 575 V, 2 HP, Three Phase Electricals are available at the same prices as those shown for 230/460 V Electricals.

ACCESSORIES:

No. 50-104 ______ Set of four Steel Legs.
No. 33-584 ______ Retractable Leaf Guard.
No. 33-212 ______ Standard Dado Head Set, 8" diameter.
No. 33-197 ______ 12" Combination Saw Blade, flat ground.
No. 33-003 ______ 12" Rip Saw Blade, flat ground.
No. 33-004 ______ 12" Crosscut Saw Blade, flat ground.
No. 33-005 ______ 12" Mitre Saw Blade, hollow ground.
No. 34-757 ______ 7" Plywood Saw Blade, 200 teeth.
No. 34-840 ______ 9" Carbide-Tipped Saw Blade, with alternate top bevel grind.
No. 34-841 ______ 10" Carbide-Tipped Saw Blade, with alternate top bevel grind.

See latest Rockwell Delta Catalog for other basic units, electrical variations and accessories available for this unit.

Form No. 33-12 (5)   Printed in U.S.A.

SCHOOL AIDS DEPARTMENT

Power Tool Division • Rockwell Manufacturing Company
554 N. Lexington Avenue • Pittsburgh, Pennsylvania 15208

Here's my order for a free set of more than 80 Rockwell Specification Guide Sheets.

Name ______________________ Title ______________________

School Affiliation ______________________________________

School Address ____

City ______________________ State ____________ Zip Code ____________

FOR THE STUDENT

Cutting a Stencil for a Poster

OBJECTIVE:

You will cut the design of the ad for the bulletin board onto a lacquer film stencil for silk screening

ACTIVITY:

1. You will need;
   - a. The design of the poster.
   - b. A stencil knife
   - c. A silk screen stencil
   - d. A drawing board

2. Get the design of the ad from the head of the advertising agency.

3. Tape the design on the drawing board

4. Tape the stencil film over the design of the ad. Leaving a two inch border on all sides. The smooth side of the film should face you.

5. Take the stencil knife and cut out the areas that are to be printed, be sure not to cut through the backing.

6. If there is more than one color in the design, you will have to cut a separate stencil for each color.

7. It may help you to put a couple of reference marks on the stencil if you are printing more than one color.

8. It may help you to put a straight edge along the lines when cutting out certain sections.

9. When you have finished cutting the stencil, lift a corner of the stencil you have cut with the point of your knife, and peel off the film

DISTRIBUTION

FOR THE STUDENT

PRINTING THE POSTER FOR A BULLETIN BOARD WITH A SILK SCREEN

OBJECTIVE:

You will print the posters with a silk screen process

PRE-REQUISITE G-64 and G-65

ACTIVITY:

1. You will need.
   - a. Squeegee
   - b. A spatula knife
   - c. Prepared paint

2. Close the frame and place some paint at the top of the frame

3. Put a sheet of blank poster paper in the guides

4. Place the squeegee behind the paint and with the frame closed down, draw it toward you.

5. Take the printed poster out and replace it with a new poster

6. Take the squeegee and push the paint away from you.

7. Repeat steps five and six as many times as needed

8. Remove extra paint with a piece of cardboard

9. Place newspaper underneath the frame

10. Clean silk with plenty of lacquer thinner until it is completly clean, or transparent.

FOR THE TEACHER

SERVICE

HOW TO CONDUCT AND AUTOMOBILE AND TRUCK SAFETY INSPECTION

Objective:

Given automobiles and trucks from the surrounding community, a testing lane, student checker, banners, and check-list material, you will test the safety of the vehicles by checking the ten (10) items listed as follows:

1. Brakes - pedal check
2. Lights - Front Headlamps (broken or not working)
   Rear Tailights
   Brake Lights
   Turn Signal Flasher
   Back-up Lights

3. Tires (Including Spare) - condition and wear left
4. Horn
5. Mirrors - cracked, broken, or missing
6. Glass - Windshields cracked, broken, or fogged
7. Exhaust System - Rusted out, broken, noisy, leakage
8. Windshield Wipers - Do they work, streaky or worn out
9. Windshield Washers - In operating condition
10. Steering - Does car turning respond to wheel turning
11. Optional Item: Seat belts

Activity:

Give the students such material as paper for banners for advertising safety check.

Have teams write a safety handout to explain usefulness of a safety check.

Have them make up by writing, typing, and duplicating, copies of the above items for safety check list for your own records and the public.

Have them make stanchions with rope attached to define limits for safety check lane.

Have a box constructed for holding the tickets that will be later tabulated.

Have them construct tire tread wear-check gauges. Also have a few under-car garage creepers handy for any under-car checking to be done.

Have at least one fire extinguisher ready for any emergency.

ASSIGNMENT OF WORK CREWS - TEAM OPERATION

Have five students work together in a crew;

1. As a checker and collator of safety information
2. Student inside car to start up, pump brakes, turn lights, wiper, washer on, check inside and outside mirrors, turn steering wheel, blow horn, turn-on turn signal, and give key to outside man to check spare tire in trunk
3. Front man to check out lights, turn signals, front exhaust, glass condition, steering gear and tire condition
4. Rear man to check out tail lights, brake lights, back-up light, turn signals, tires, exhaust system (tailpipe primarily) and spare tire in trunk.
5. Utility man to check out exhaust system, back of front tires, front of rear tires and tread depth, (outside mirror optional) glass, and assist the checker or inside man whoever needs assistance.

After vehicles have been checked, (You should allow at least two days for this operation. Owners can have cars rechecked, and the word will spread to the point where you will have from 100 to 200 vehicles to be checked) collate your results into the ten different categories and see what is the prominence of repair needed, faulty systems and parts, and which of these were in need of greatest repair.

Have an oral quiz with your students. Find out which items were most often in need of repair and replacement. If their answers are incorrect or unsure you can have them analyze the results of their efforts and write up a report on it as a final class project.

FOR THE STUDENT No. H-1

SERVICE

THE APPLICATION OF THE BATTERY HYDROMETER

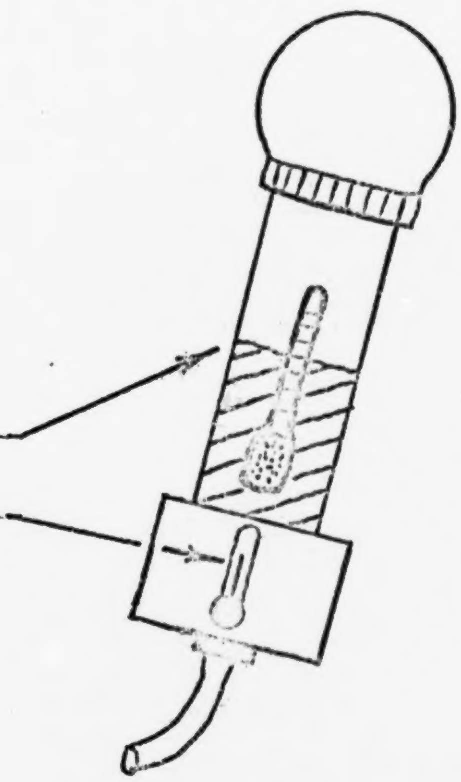
Objective:

You will be given several batteries and a hydrometer, then you will use the hydrometer and pick the correct statement applying to each of the batteries you test.

Activity:

Follow the directions below and place your answers in the spaces provided on page 2.

1. Get the hydrometer from the tool panel.
2. Locate the test batteries numbered 1 to 5. Perform the following operations on each battery.
3. Remove all the battery caps.
4. CAREFUL!! Do not get acid on your skin or clothes. If you do, wash with lots of water and tell the instructor immediately.
5. Put the hydrometer vertically into the battery; slowly squeeze the bulb, then release the pressure to draw the fluid (electrolyte) into the hydrometer.
6. Fill the glass section of the hydrometer about ½ full of fluid.
7. If you cannot get enough fluid from a cell, fill with clean water (distilled, if possible) and recharge the battery before taking the reading. Caution - do not overfill.
8. When the float moves freely in the fluid -
   Take your specific gravity reading from here
   Take your temperature reading from here
9. Return the electrolyte to the same cell from which it was taken.



10. The cells in the battery are separate compartments, therefore, you must take a hydrometer reading from each cell.

11. Follow steps A through G below and record the readings from each cell of the battery. This will give you (1) a specific gravity reading (corrected for temperature), (2) the maximum variation between the battery's cells (specific gravity).

12. Use the diagram below to record the results of your tests for battery #1. Make yourself a similar record sheet for batteries 2 through 5.

(A) Record temperature here

(B) Record specific gravity or float reading here

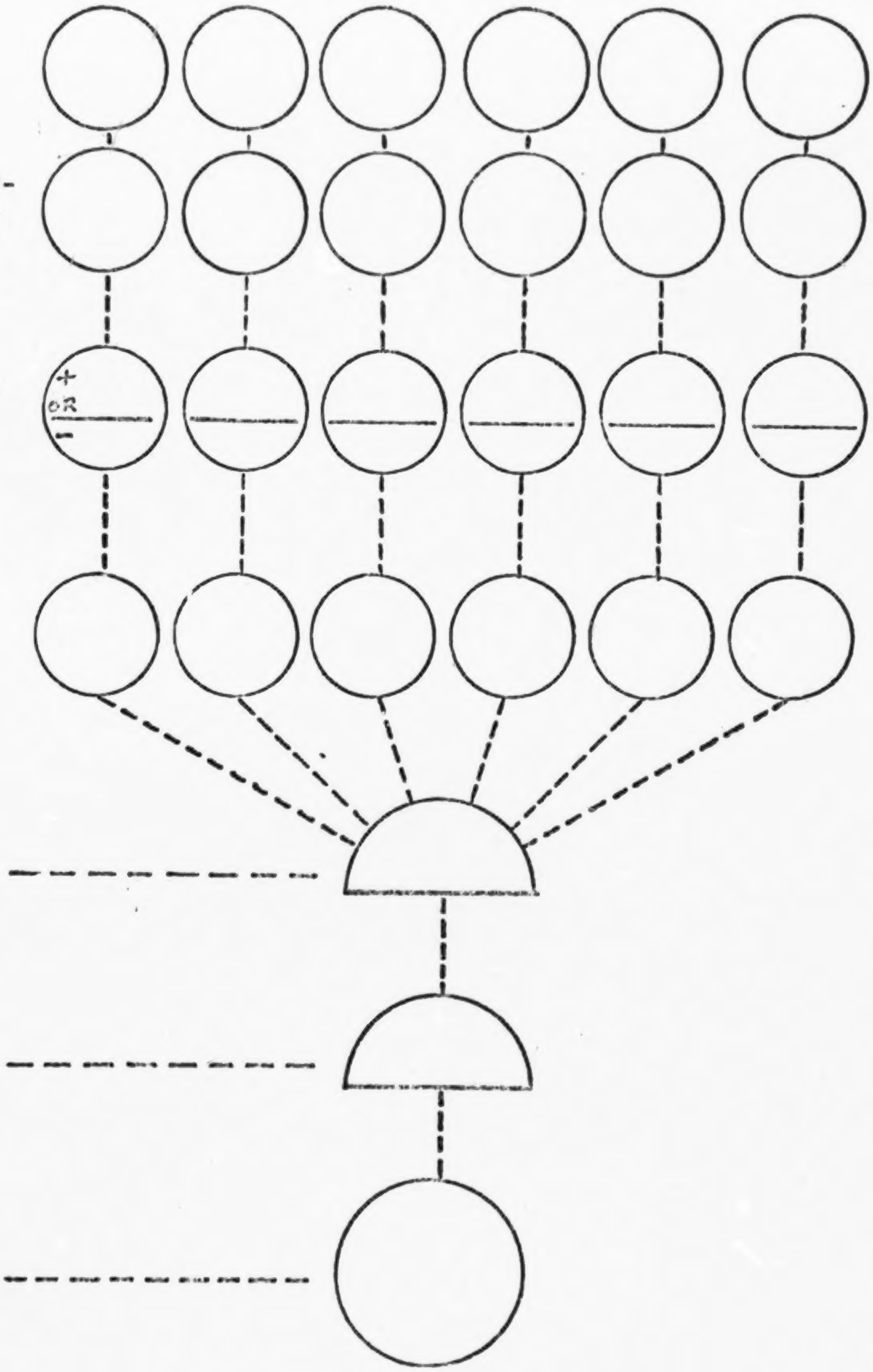
(C) Add .004 points to specific gravity reading for each 10° above 80°F. or subtract .004 for each 10° below 80F.

(D) This gives you a temperature corrected specific gravity

(E) Place highest corrected specific gravity reading in this space

(F) Place lowest corrected specific gravity reading in this space

(G) Subtract F from E. This will give you maximum variation between the battery cells



NAME________________________________

Post test:

Read the general information below and use your test results to pick the statement that best describes the conditions of each of the five batteries you tested.

General Information

1. Specific Gravity should not vary more than .025 points - between the highest and lowest cell readings. If it does, the battery is defective.

2. Battery State of Charge

Specific Gravity Amount of Charge

1.265 - 1.299 ----------------- Fully charged battery

1.235 - 1.265 ----------------- Three-fourths charged

1.215 - 1.235 ----------------- One-half charged

NO OTHER BATTERY TESTS SHOULD BE RUN IF THE BATTERY IS LESS THAN 1/2 CHARGED

1.170 - 1.215 ----------------- One-fourth charged

1.140 - 1.170 ----------------- Barely operative

1.110 - 1.140 ----------------- Completely discharged

Place your answer in the circle for each of the five batteries.

Battery #1 ---○

Battery #2 ---○

Battery #3 ---○

Battery #4 ---○

Battery #5 ---○

(A) Battery is defective

(B) Battery has a full charge

(C) Battery is half charged

(D) Battery needs to be charged before any further testing can be done

(E) Battery is discharged

SERVICE

THE PAINTER

Objective:

Given paint and brushes, and wood, metal, and a synthetic surface, you will apply paint to each surface.

Activity:

1. Get paint and brush kit from tool room or supply clerk.

   List of materials is:

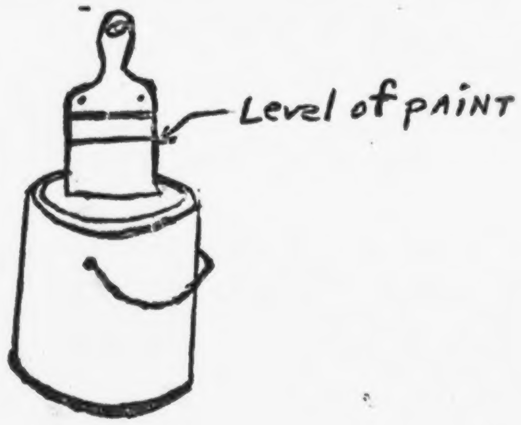
   1. Can of paint
   2. Brushes - 1", 2", and 4"
   3. Mixing or stirring stick
   4. Clean Rag
   5. Screwdriver to pry open lid
   6. Clean paper or small dropcloth to put under work
   7. Turpentine and small can to clean brush up after painting.

2. Open can and stir paint until entirely blended for at least 2 minutes.

3. When paint is an even consistency, spread paper on work surface, put piece to be painted (wood, metal, or synthetic material) on top, and then wipe piece with cloth to remove any dust, dirt, chips, etc. which would cause the paint to spread unevenly or to streak or smear.

4. Take brush and fan bristles slowly over the palm of your hand to clean out or remove any dust, or foreign material.

5. Now you are prepared to paint, dip your brush from 1" to 2" into paint can. This will give the brush enough paint without overloading the bristles with too much paint.



6. Stroke the material being painted with the brush. Each stroke should be from 6" to 8" in length. Then, without adding more paint, brush in the opposite or crosswise direction over the painted section. Going crosswise in direction will remove streaks while completely filling in and evening out the paint.
7. Continue painting, and finish the material.
8. When finished, examine for any spots you have missed or any area that is streaked or not filled in completely.
9. When completely satisfied that the painting is completed, take the material by the edges and place it lengthwise in a drying area so it will not stick to the paper or covering while drying.
10. Now finish the other two surfaces.
11. When completed and dried for inspection, get the foreman or teacher to check your work.

FOR THE STUDENT

No. H 6

SERVICE

AERONAUTICAL SERVICE PROBLEM

Objective:

Given paper and directions you will proceed to make an extremely ultra-dynamic controlled conditioned type aeronautical modular-type vehicle.

Activity:

First one must be aware of what one must do. So first proceed to the sink or washroom and proceed to clean your hands thoroughly, because this must be worked on under the cleanest of conditions so as to maintain the cleanest aerodynamic stableness and least turbulence.

1. Fold this paper in half.
2. Now fold one side of the paper at a 30° angle from front to back.
3. Now do the other side.
4. When this is done, fold again, this time at about half the width of the paper, again at approx. a 30° angle.
5. Now repeat this on the other side of the folded paper.
6. Now that both sides are folded, you should have a pointed tip in the front and about 1 to 1½" width at the rear.
7. If so, proceed to next step which is, take leading edges of each side and flaten over to about 3/4 to 1" in width to make a tail.
8. You should now have a finished product.
9. To test, aim high and wait for proper wind and toss hard or hurl lightly depending upon the teachers will power and wind velocity.
10. If you are not to good at folding follow dotted lines on back of package. GOOD LUCK.

SERVICE

THE SERVICING OF TRANSISTORS BY USING A CRYSTAL SET (RADIO) FOR A DEMONSTRATOR

Objective:

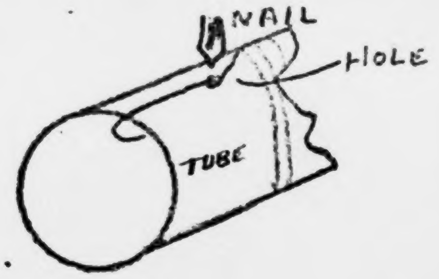
Given the materials for constructing a crystal set, and a transister to use in place of a crystal, you will install the transistor correctly for proper radio reception; and then reinstall it incorrectly (in reverse) to demonstrate that a radio signal will travel in only one direction in the transistor.

Activity:

Prerequisite skills should include ability to use simple hand tools and the use of a soldering iron or gun. The wiring, setting up, and building of the crystal set will be explained in this package.

1. Get required tools and supplies from your supply room. These tools and materials should include:
    1. Block of wood 6" x 4" (9" x 6" if larger unit is wanted.)
    2. One transistor (Germanium type)
    3. One paper roll (from toilet tissue roll or paper toweling-cut in half)
    4. Approx. 18 to 20 feet of fine gage (18 or 20) copper wire, insulated type (enameled)
    5. 1 to 2" wire of acid-core solder
    6. Two small nails or heavy thumbtacks
    7. Metal pin from 3 to 4" in length (for picking up radio signal from copper wire on paper coil)
    8. Electrical tape
    9. Earphone headset (or ear-plug type receiver)
    10. 6 ft. length of wire for aerial lead
    11. Soldering iron or gun
    12. Pliers (needlenose preferred)
    13. Small hammer
    14. Wire snips-optional
2. Take paper roll and wind fine gage wire around, (when winding wire do not overlap because it will give you a distorted signal and will make it hard for the slide to come in proper contact) being sure to leave enough at both ends for tieing.
   Note: The wire must be enameled (or insulated) so the current traveling around the coil will run in one path instead of running down the coil.

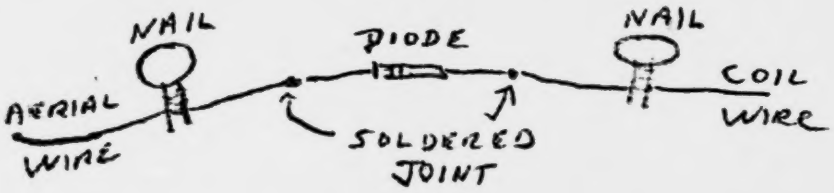
3. Punch a small hole at one end of the tube and insert wire through. Pull through and tie around tube in a loop. (You can use a nail to make this hole.)



4. Take the other end of your coil wire and tie to your Germanium diode, making sure you have tied to the receiving end of the diode. Here you will have to make a decision on which is the input end, and which is the output end. If you don't receive any signal,you have the diode reversed and you cannot draw the radio signal through. (Think of the diode as a gate which only opens in one direction.) Use your pliers to make a strong splice.

5. Wrap the electrical tape around your coil about one half inch from the ends and proceed to wind around wooden block or crystal set base. This will secure your coil neatly in place and prevent movement when using the slide to bring in stations or reception.

6. Now nail in the two nails below the coil (as shown in drawing) about an inch to an inch and a half apart. Your coil wire and aerial lead wire will be wound around these and then the nails will be driven in to secure them and the diode in place. Then solder joints.



7. Attach a wire to your slide pin, then solder (on the end) and run it to the coil-diode wire connection. (See drawing last page.)

8. Attach your earphone or earplug listening device to the connection between the slide and the diode wire (as shown in drawing.)

9. You can now solder the connections. This will insure you a tight connection where the current will run through. Be sure to use the flux type solder because this will cause the solder to stick better.

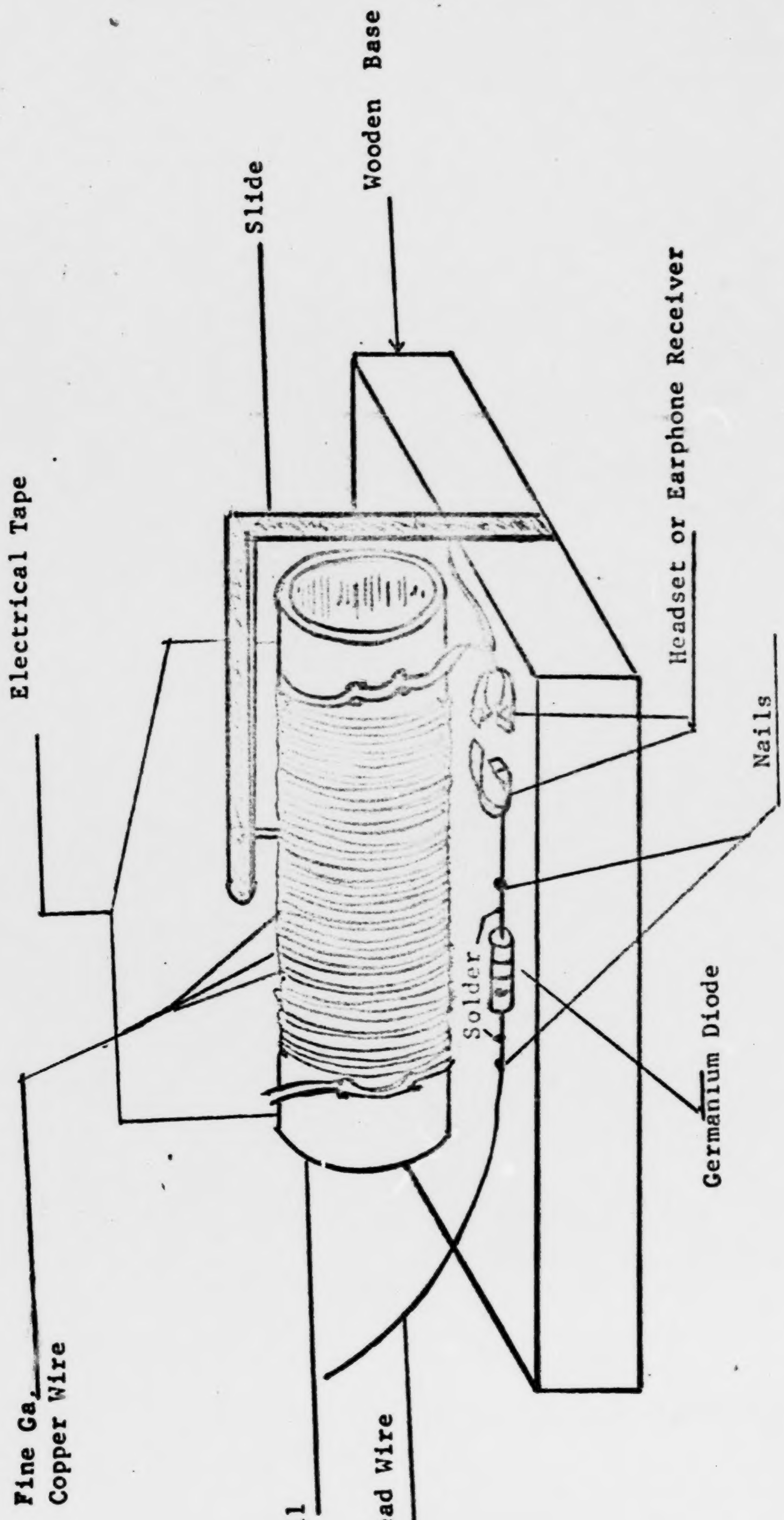
10. Check your work for any loose wire or soldered joints and any slack or unraveling of the coil wire. If O.K., you can now ground your aerial wire (by tieing to a metal object, such as a metal radiator or metal window screen) and by moving your slide slowly over the coil you can pick up radio signals. If you are not receiving, your diode is in backwards. It must be reversed to receive a signal.

11. Have your teacher or foreman check your work and check the receiving of your radio signal. It should come in clear enough to be heard.

ADDITIONAL ESSENTIAL INFORMATION

The principle involved in a crystal set is that it is a convertor of radio waves into voices. It achieves this by an aerial bringing in the radio waves. The diode then sends them on to the earphones. Also the aerial sends them to the coil which weeds out the different stations. The slide connects the coil to the earphones. The slide is grounded to take out the static.

Definition of a diode: A nonvacuum electronic device similar in uses to the electron tube, whose control of an electron current is effected by the conducting properties of a semiconducter, such as germanium.


Fine Ga. Copper Wire
Paper Roll
Aerial Lead Wire
Electrical Tape
Slide
Wooden Base
Headset or Earphone Receiver
Nails
Solder
Germanium Diode

TEACHER PACKAGE

No. H 8

SERVICE

PROBLEM SOLVING - SMALL GASOLINE ENGINES (2 CYCLE)

Objective:

The student will develop problem solving skills by applying the techniques of trouble shooting from a step-by-step procedure for a fuel supply problem.

Activity:

The teacher will discuss problem solving and give the students activity in techniques of trouble shooting by causing purposely placed malfunctions in the fuel system of a two-cycle gasoline engine.

A. The development of this activity will follow: 1. Step-by-step procedure, 2. Cause and effect relationships, and 3. Use of the senses for diagnosis.

B. Step by step procedure

1. Fuel supply
   a) Tank level, b) Stale gas
2. Gas cap
   a) Cap vent, b) Fuel line
3. Tank valve
   Open all the way
4. Reset needle
   a) Slow speed, b) High speed, c) Check governor, d) Spark test
5. Spark test
   3/16" jump, b) Constant spark
6. Spark plugs
   a) Wet, b) Dry, c) Gap, d) Carbon, e) General condition
7. Air intake
   a) Air cleaner, b) check blow-by
8. Remove float, bowl cap
   a) Bowl filled, b) Bowl empty

C. Techniques in trouble shooting

1. Sight - What to observe, What to expect
2. Flooding - Caution
3. Sound
    a. Surging, knocking, etc.
    b. Plugged parts, Lack of lubrication
    c. Introduce engine running properly

D. Trouble shooting in action by setting up problems

1. Set plugged high speed needle
2. Set reed valve - Reversed
3. Set governor vane - Turned
4. Simulated plugged muffler
5. Set noisy starter or plugged by-pass
6. Simulated plugged line

E. External trouble - Power loss

1. Tight reel
2. Clutch adjustment
3. Tight rollers
4. Tight wheels
5. Improper operation
6. Storage problems that cause power loss
7. Improperly lubricated bearings

F. Summary

G. Demonstration and operation

HAND TOOLS RECOMMENDED

¼" to 9/16" open end wrenches
5/16" to 3/4" box wrenches
5/16" to 3/4" socket wrenches

Hammer, screw driver, pliers, feeler gage, flywheel removing tools

Coil and condenser testing equipment

ENGINES USED FOR DEMONSTRATION

Briggs & Stratton
Clinton
Jacobsen
Lauson
Wisconsin

VISUAL AIDS AND LITERATURE

Clinton - Charts and Literature
Briggs & Stratton - Charts, Manuals
Jacobsen - Cut-a-way Model, Literature, Strip Film and Parts
R. E. Phelon Company - Magneto Manual

TEACHER PACKAGE

SERVICE

TROUBLE SHOOTING - TESTING - TWO-CYCLE

Objective:

The student will troubleshoot a two-cycle gasoline engine when given an engine with teacher prepared malfunctions.

Activity:

1. Preprequisite for this package is Service Package No. H 8.

2. Review package H 8, and problem solving techniques.

3. Possible problems for solving.

   A. Engine races - Governor vane - Twist
   B. Fouled plug - Narrow gap
   C. Surging - By-pass tube assembly plugged
   D. Plugged air cleaner - Close off air
   E. Reed valve - Reversed
   F. Loss of power - Plugged muffler
   G. Engine races - Bad seal
   H. Will not idle - Butterfly not closing
   I. Will not start - Plugged screen
   J. Will not start - Plugged line
   K. Loss of power - Governor setting
   L. Will not start - Plugged high speed orifice
   M. Will not idle - Broken idle mix screw
   O. Engine misfires - Broken or worn ignition wire

NOTE: These trouble shooting problems should be given one at a time, depending upon the students ability. Should you see that he can handle more, then one or more problems at a time can be given. No more than five problems should be given at one time.

4. Review problems

5. Demonstrate ignition timing and tear down

6. Demonstration and testing - Participation of class

7. POST TEST ON TWO-CYCLE ENGINES

A. Name three causes of engine surging.

B. Give, in order, seven troubleshooting steps for a "will not start" condition.

C. What are the most common causes of power loss?

D. Give a brief explanation of the two-cycle principle.

E. What type of gas and oil is most commonly recommended for 2 cycle engines?

FOR THE STUDENT

No.H 10

SERVICE

IDENTIFYING FLUID POWER TECHNICIAN WORK DUTIES AND CAPABILITIES

Objective:

Given the occupational job title of; Fluid Power Technician, a service oriented occupation you will study the ten duties listed and be able to give an oral or written list of five of them.

Activity:

H
First refresh your memory of service packages No.s 3,4,23,26, 30,31, and 33 to help define the duties of a fluid power technician. Next study the ten duties listed below. If you need any help or additional information to help round out the duties, see the teacher or the foreman.

1. Inspects and Diagnoses Faulty Operation
2. Installs and Maintains Pipe, Tubing and Hoses
3. Installs and Maintains Valves
4. Installs and Maintains Pumps
5. Installs and Maintains Cylinders
6. Installs and Maintains Hydraulic Filters
7. Insures Compatible Fluids for Systems (See package H 36)
8. Has Working Knowledge of ASA Symbols
9. Knows Fundamentals of Hydraulics and Pneumatics
10. Assists Engineers in Assembling and Testing New Components and Systems

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-10

Conduct an oral quiz with your students to see how much knowledge they have concerning this occupation. If they are very successful have them study another service occupation. If not, give them the package and have them study it along with the other service H packages listed on the front (3,4,23,26,30,31,33, and 36).

When a student is interested in one of the ten listed duties and wants more information you can give him additional information from the D.O.T. Code 5-83 - Fluid Power Technician - Fluid Power Job Analysis, attached to this package.

You can either give it to him in one of two ways; One)clip out each of the ten duties on separate slips which you can hand out to the interested student and have him hand back when he is finished, or Two) if he does real well with his oral examination and wants to gain as much information as possible you can run off extra copies which can then be handed out as needed.

If the students interest is going well you can make up other job analysis for the students to study and gather information on.

Note: Be sure and point out to the student the Skills and Education information at the end of the D.O.T Job Analysis Section. This will help reinforce his understanding of what is needed to become a sucessful fluid power technician.

FLUID POWER JOB ANALYSIS

Occupational Title: Fluid Power Technician
D. O. T. Code 5-83

DESCRIPTION OF OPERATION

Perform any combination of following duties to install, inspect, maintain, repair and service hydraulic and pneumatic (fluid power) components and systems in die-casting operations, plastic manufacturing, construction equipment, farm machinery, road machinery, packaging machinery, automation equipment, assembly equipment, tool and die equipment, computers, mining machinery, materials handling equipment, machine tools and other fluid power applications:

1. Inspects and Diagnoses Faulty Operation:

Inspects hydraulic or pneumatic components, pressure lines, hose lines, oil reservoir, air systems, heat exchangers for damage or external wear. Checks accumulators for proper precharge, pump shaft for proper alignment, suction inlet for restrictions, unusual pump noise, filters for proper operation and replaces element when necessary. Checks relief valves for recommended pressure setting, directional control valve for proper operation, motors for speed at rated flow, cylinders for worn or defective packings. Repairs or replaces defective parts or components. Operate and adjust the equipment for optimum operation to meet manufacturer's specifications.

2. Installs and Maintains Pipe, Tubing and Hoses:

Installs interconnecting pipes, tubes, hoses and fittings of hydraulic and pneumatic systems using standard and special power and hand tools to cut, bend, braze and install fluid conductors. Cleans all parts with prescribed solvents, water and other chemicals to remove scale, grease or foreign matter. Apply rust preventive to interior surfaces to reduce rust and corrosion. Seals or plugs openings to exclude foreign matter prior to storage. Uses extreme care to handle and store dangerous chemicals where used in operation of fluid power systems.

3. Installs and Maintains Valves:

Studies manufacturer's manual specifications for valve recommendations for fluid power employed, working temperature, and pressure limits of system. Installs valves and packings using wrenches and other hand tools. Tests valve installation and seating by starting system, turning valve slowly to open position and observing valve for pressure loss and leaks. Makes adjustments as required or shuts down system and disassembles valve to locate and correct malfunction. Reassembles and installs valve. Examines valves regularly for cracks, dents and fractures and discards faulty valves to prevent serious equipment damage or worker injury due to possible bursting under high pressure operation. Checks for ease of operation, excessive leakage, proper function, pressure ratings and flow capabilities.

4. Installs and Maintains Pumps:

Studies manufacturer's manual recommendations for installation, operation repair and maintenance for type, capacity, driving power and other characteristics of pumps used in systems. Diagnoses pump failures or malfunctions, checking various mechanisms, lines, filters, valve power unit gages, pressures, temperatures, oil viscosity and for defects such as air or oil leaks, excessive heat and noise, clogging, misalignment, insufficient oil or operating pressure, stalling, broken, worn or stock parts. Dismantles and disassembles part or component from system using hand tools such as wrenches, pliers and screw drivers. Cleans and corrects malfunctions or replaces damaged or worn part, and reassembles. Tests pump system while running and adjusts controls to obtain optimum operation. Oils and lubricates moving parts as required.

5. Installs and Maintains Cylinders:

Mount cylinders according to manufacturers' recommendations. Connect lines. Check for external leakage and alignment. Adjust cushions and trip devices to give proper operation. Remove cylinders and/or cylinder parts for servicing. Check for seal and metal wear. Replace worn seals and metal parts. Reassemble. Check for external leakage and breakloose. Reinstall. Check and report unusual performance conditions.

6. Installs and Maintains Hydraulic Filters:

Install according to manufacturers' recommendations. Check pressure drop at various flows. Check for external leakage at system working pressure. Check operation of contamination indicators. Remove contaminated elements. Clean reusable elements. Install cleaned or new elements. Check seals and replace if necessary. Complete reassembly. Check for external leakage and report unusual performance conditions.

7. Insures Compatible Fluids for Systems:

Must be familiar with various types of industrial hydraulic fluids and their effect on the operation of a particular type of system. Must understand viscosity, viscosity index, specific gravity, water content and seal and packing compatibility of fluids in relationship to system operation.

8. Has Working Knowledge of ASA Symbols:

Must be familiar with the latest ASA hydraulic symbols. This includes both the correct understanding of ASA symbols furnished with the equipment and the use of symbols to denote any design changes made on the original equipment.

9. Knows Fundamentals of Hydraulics and Pneumatics:

Must have a working knowledge of the basic principles of fluid power relating to compressibility, flow, force, pressure, pressure drop, work, power and toque.

10. Assists Engineers in Assembling and Testing New Components and Systems:

Assembles and tests new and experimental fluid power components and systems such as motors, pumps and valves under supervision of engineers, using hand tools such as wrenches, pliers and screw driver. Makes recommendations to engineers developing new applications for hydraulic and pneumatic components.

SKILLS AND EDUCATION REQUIRED TO PERFORM THESE DUTIES:

Skills: One who is moderately skilled in the use of tools of several trades rather than specializing in one. These trades encompass the following: Machinery mechanics, electrician, plumbing and some welding.

Education: One who has knowledge of machine design, blue print and diagram reading, mechanics, basic electricity, basic hydraulics, systems application, and understanding of the terminology and symbols used in these various trades.

FOR THE TEACHER

SERVICE

HARDWARE STORE SALES

Objective:

Given specifications for a job, requiring filling a cast-iron pipe joint, the student will plan and place an order to obtain all needed supplies and material for that job, stating all necessary size and type specifications. Another student will act as the supplier and will be given requirements of the occupation and the activities needed to fill the order of the student customer.

Activity:

This activity should involve at least two students, acting as hardware supply man and customer. The customer will supply the order for the job and will outline his requirements. The hardware supply man will make a judgement as to the correctness of the needed materials, and will fill the order to the customer's satisfaction. This activity can also revolve around the use of plumbing catalogues, and the use of order forms and requisition sheets. See note at end of package.

The problem is defined as the need to order materials and tools to be used for making a cast-iron pipe joint. From this the hardware supply man or clerk (with some help from the customer, if needed) will fill the order. He can use his experience, books, catalogues; or this can be established as an outside assignment, requiring a visit to an actual hardware store.

Problems that might develop, requiring the assistance of the customer are:

1. What is the length of the cast-iron pipe needed, and what type of joint is to be repaired?
2. Will the type of pipe require a spigot and hub, or can it be the type with hubs at both ends?
3. What is the thickness needed for the wall of the pipe and, consequently, what additional tools are needed?
4. Are any marking materials required,(for cutting etc.?)
5. What type of lead will be needed for the joint? (Can hot or cold packing types be used?)
6. Is it possible to make a joint without using any solder? Is there a new way? If so, what is it?

With these main points in mind, the students, particularly the one acting as the hardware supplier, will attempt to fill the order by either recommending accepted tools and materials, or by devising another way specifying new materials and processes.

The results should be checked with the teacher or foreman, against materials specified to do this job in package No. H 3. Innovative methods and/ or materials should be checked by outside experts for accuracy. The criteria to keep in mind is: Can the job be successfully completed with the materials and processes supplied?

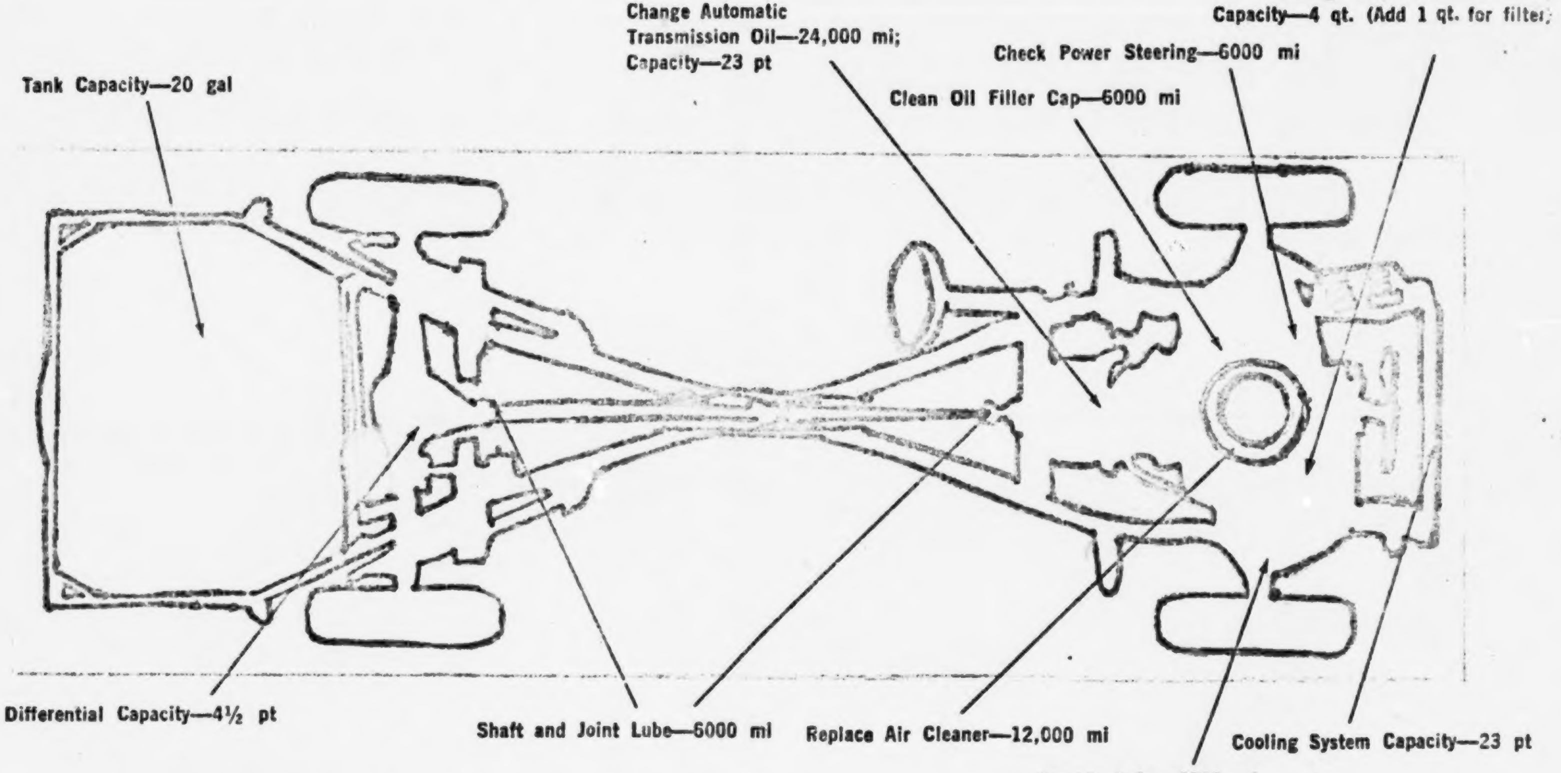
NOTE: Since the objective for this activity is the ability to communicate and work with the technical language, a similar assignment could be devised using any other materials or processes relevant to the activities in your laboratory.

SERVICE

AUTOMOBILE LUBRICATION AND FLUID CAPACITY GUIDE

Objective:

Given an automobile placed on a hoist, you will be able to observe and point out the locations for fluid changes and what fluid capacities are needed with the aid of the diagram shown below.


Change Oil, Filter—6000 mi; Capacity—4 qt. (Add 1 qt. for filter)
Change Automatic Transmission Oil—24,000 mi; Capacity—23 pt
Check Power Steering—6000 mi
Tank Capacity—20 gal
Clean Oil Filler Cap—6000 mi
Differential Capacity—4½ pt
Shaft and Joint Lube—6000 mi
Replace Air Cleaner—12,000 mi
Cooling System Capacity—23 pt
Chassis Lube—6000 mi

Activity:

When car is placed on hoist, point out the different locations of fluid and hydraulic reservoirs, based on the above diagram. Familiarize yourself with the proper capacities needed for the different systems, and the location of the drain plugs, petcocks, and lubrication points needed for service work on the automobile.

Restudy Service Package No. 36 on the quality of different lubricants.

As a post test the teacher will give you a drawing of this diagram with the points blocked out and you will be asked to identify five of the ten points shown that are used for lubrication or lubricants and the mileage required for change, on seven of the items.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-12

This lesson is designed to excite and arouse the curiosity of the student as to automobile lubrication points and fluid capacities.

Objectives of the lesson are met if students learn where lubrication takes place on the automobile and what capacities of fluids are needed in the different systems.

These objectives can be met by assistance of the teacher in obtaining different lubrication manuals and books from the different gas and oil companies (nationwide) who give these out free to anyone requesting them. They give exact and accurate location of all cars and most trucks, or grease fittings, oil plugs, and complete capacity information (for all years) pertaining to water, anti-freeze, oil, grease, gear lube, and transmission fluid and dope.

This additional information will enable and assist you to give a complete picture to your students who need and desire information on this topic.

Use a thermofax to copy additional copies of the drawing shown so you can test the students ability to locate the information wanted. Be sure to block out the title, but leave the arrows, so the student can print the answer to the questions.

FOR THE STUDENT

No. H 13

SERVICE

REPLACING A FRONT WHEEL-INNER GREASE SEAL

Objective:

You will be able to properly install a front wheel-inner grease seal, given the following tools and materials.

1. Pliers
2. Side cutters (snips) optional
3. screwdriver, straight blade
4. Rubber hammer
5. Block of wood (optional)
6. New grease seal
7. Wheel bearing grease (also optional)
8. cotter pin
9. Clean rag
10. Hydraulic floor jack

Activity:

1. Get the tools and materials and take them to your work station

2. Place floor jack under front A frame of automobile, after placing automobile in park position, and jack up automobile until the front tire just clears the floor.

3. Remove the hubcap with screwdriver.

4. Pry off grease cap with screwdriver, by placing edge under cap in one location and then another until cap is forced up from its deep-set position.

5. Remove cotter pin, with pliers or by cutting with snips and then unscrew locking nut with pliers.

6. Next, remove the outside steel washer, and shake tire with both hands to loosen outside front wheel bearing.

7. When bearing is loose pull out with fingers and place on clean surface, such as a shop towel or paper towel. Check for condition and amount of grease in bearing. If needed, must be re-greased before being re-installed.

8. Now pull wheel and tire forward off the spindle, being careful not to force it and cause any damage to the brake shoe linings.

9. Turn wheel over and place screwdriver under lip of inner grease seal and pry up and out with the old seal.

10. Before installing new grease seal, check inner bearing and any nee for additional grease. If needed, regrease.

11. Clean out seal retaining area with a clean rag. Remove all loose grease and dirt.

12. Place seal face up (metal portion) and squarely in the hub.

13. Tap gently with a rubber hammer around the outside circumference of the seal until it is firmly in place (with the top surface of the seal flush with the top lip of the hub.)

14. If the seal will not tap into place gently (do not force it) (it will bend or warp out of shape) place wooden block on top and you can tap with more force and cause even pressure downward along the whole surface of the seal without damage. Note:You can sometimes check the seal number on the too surface of the seal with the old seal to be sure it is identical and the correct part number. This is true in most cases, but not all.

15. With seal firmly in place check for any any snags or rough spots on the spindle. If so, sand down with emery cloth.

16. Check brake shoes before reinstalling wheel and drum. If shoes are greasy or oil soaked they must be replaced because they can not be cleaned since the grease has soaked in and cannot be gotten out.

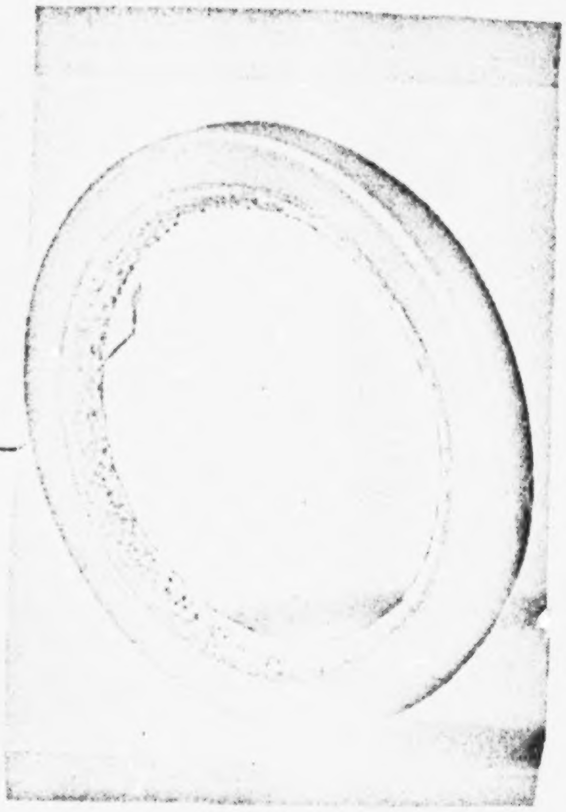
17. Put wheel gently back on spindle, do not brush or spindle will nick and damage new seal.

18. Reinstall outer bearing (with grease if necessary) washer, and tighten down nut until it is even with hole in spindle for cotter pin.

19. Insert new cotter pin and twist over and apart the two sides, snip off ends if they are projecting to much.

20. Knock back grease cap with rubber hammer until seated and replace hubcap and let down automobile off floor jack.

21. Have instructor examine your work when finished and just before remounting wheel on car to see that seal is correctly seated.



Seal nicked by wheel spindle

Proper procedure for removing wheel and tire assembly off,from spindle

FOR THE STUDENT

SERVICE

REPLACING A LIGHT SWITCH

Objective:

Given three light switches; two-way, three-way, and four-way (common household 120 Volt, 15 Amp. AC type), you will be able to select a three-way light switch and install it in correct working order.

Activity:

1. You should have the following electrical skills; A) identification of the purpose of each wire, based on wiring color codes, B) recognition of different commonly used light switches, c) the use of screwdrivers (both phillips and straight blade types) for installation of an electric light switch, and D) the previous completion of Package No. H 5.

2. IDENTIFYING INFORMATION:

   2 way switch (or single pole): simplest of switches, used to control light from only one location. Has only two terminals for connecting wires..

   3-way-switch: this type of switch is used to control a light from two different locations. For example, you can turn an upstairs light on from the foot of the stairway, then turn it off from another switch at the head of the stairs. It permits you to turn a light on or off from either switch, regardless of the position of the other. This switch has a pair of brass terminals and a single darker one, often copper colored. The dark one is called the "common" terminal.

   4-way-switch: Less common than the 3-way, this switch permits a light to be controlled from more than two locations. This switch has four terminals for connecting the wires.

3. Get a kit with three types of switches, two types of screwdrivers (phillips and straight), electrical tape if necessary, and wire pliers (if additional insulation has to be stripped off.)

4. Your first step in beginning work is always to shut off the current. If fuse-remove completely.
   If circuit breaker-shut off.
   HAVE TEACHER CHECK YOUR WORK AT THIS POINT.

5. Remove the switch cover-plate by removing the screws that hold it on.

6. Remove screws holding switch to box.

7. Unscrew the terminal screws on the side of the switch part way, and disconnect the wires. (If you are unsure of your ability to connect the new switch correctly, remove the connecting wires from the old switch one at a time, and connect them one at a time to the corresponding terminals of the new replacement switch.)

8. Now remove the switch, by pulling it straight out from the box.

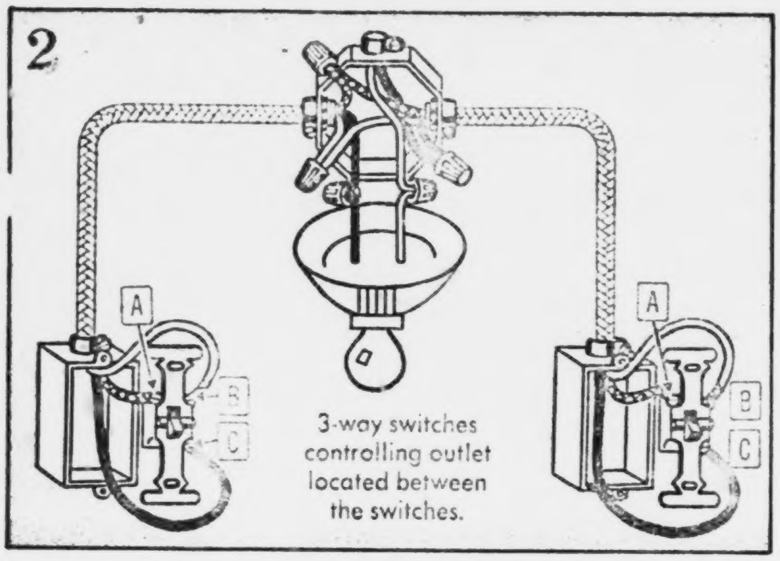
9. Select the correct replacement switch.

10. Wiring should be checked before cover plate is replaced. If wire is frayed or needs repairing, remove bad insulation or use electrical tape and repair before remounting wires. Replace wires to proper terminals.

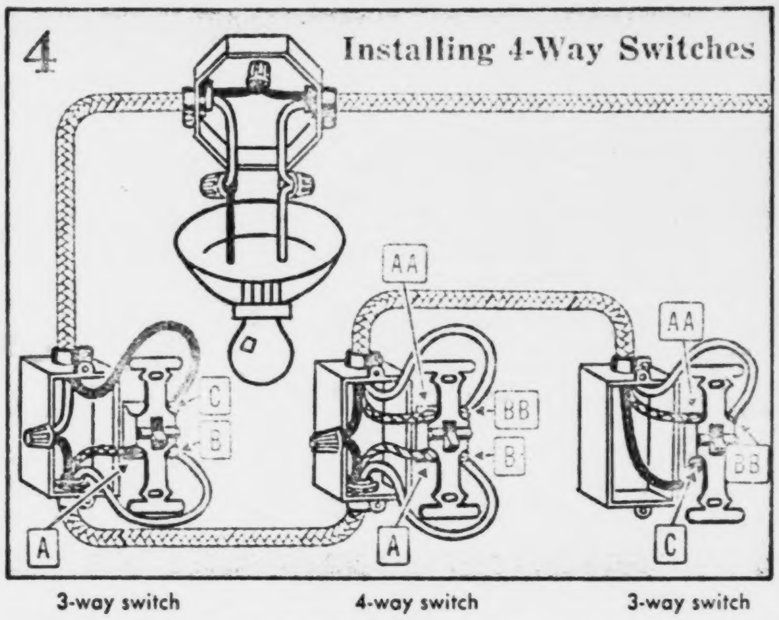
11. Have your teacher check job for correct installation and use of proper type switch. Also give an oral explanation of why you used that type of switch. Note: Do not turn current on until after teacher checks job and cover-plate is on.

12. Screw the switch back into box.

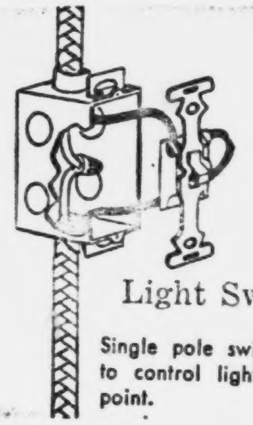
13. Screw the switch cover-plate back on.



3-way switches controlling outlet located between the switches.

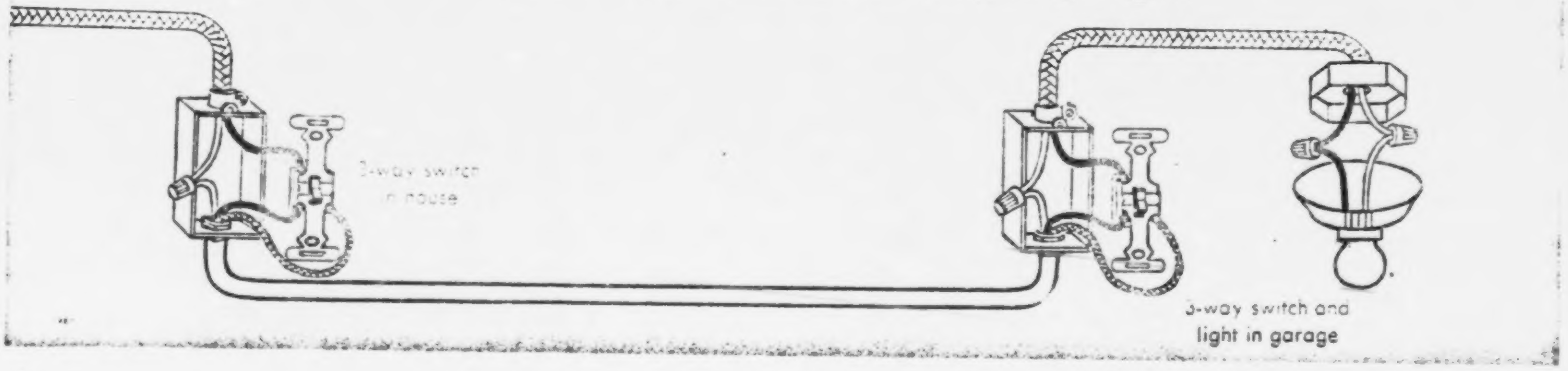

4
AA
AA
C
B
BB
B
BB
A
A
C
3-way switch
4-way switch
3-way switch

Installing 4-Way Switches

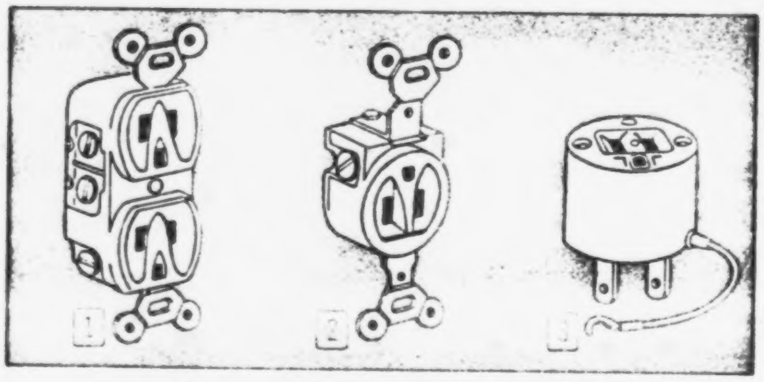


Light Switch

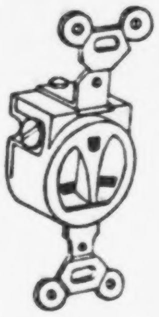
Single pole switch, used to control light from 1 point.


3-way switch in house
3-way switch and light in garage

Use of a 3-way switch to control garage light



UL Approved 3-wire devices



Single receptacle with tandem blades and U-shaped ground, are available in two sizes.

FOR THE STUDENT

No.H 15

SERVICE

DESIGN YOUR OWN SERVICE GARAGE

Objective:

Given examples of garage floor plans (layouts) and garage equipment cutouts you will design the most efficient garage floor plan to meet your needs.

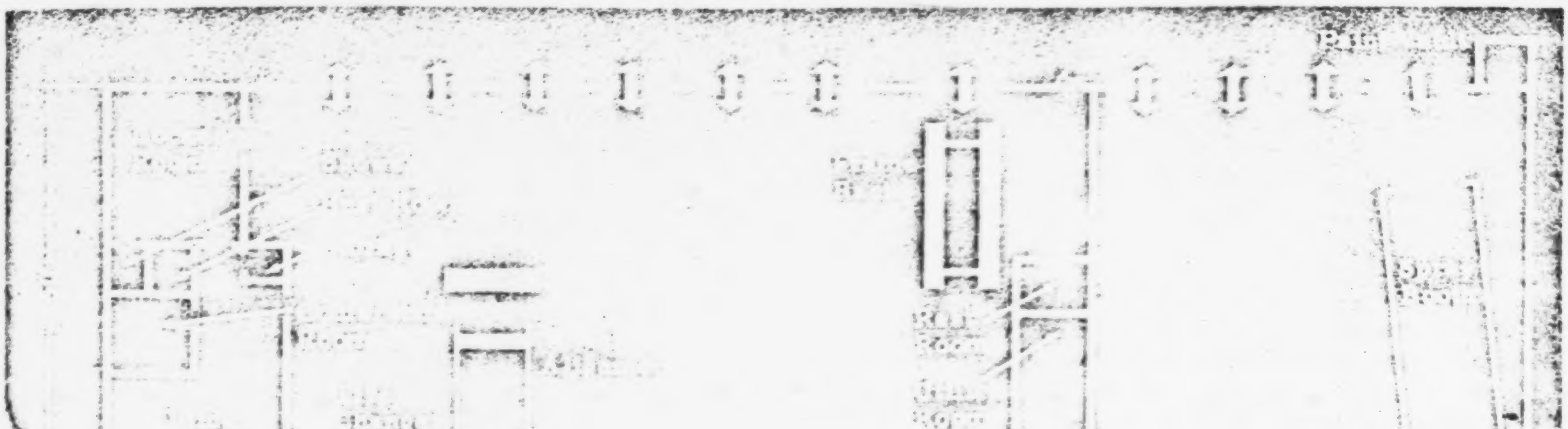
Activity:

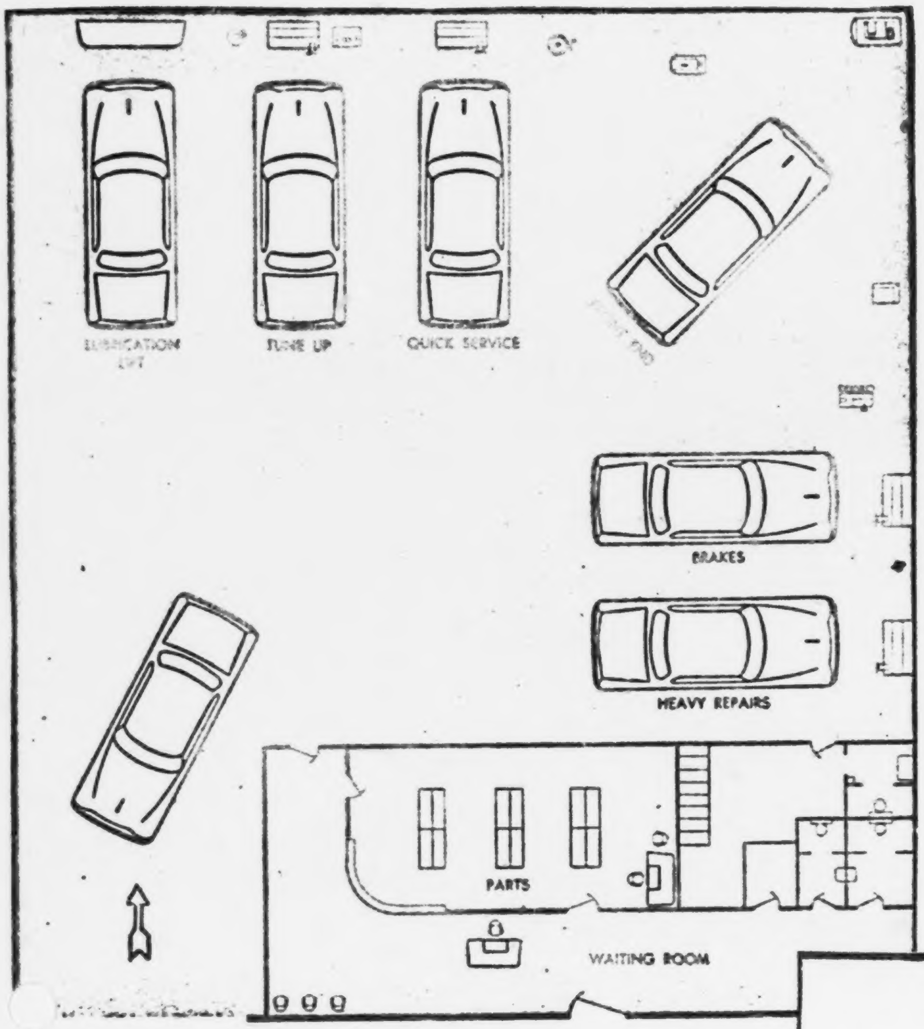
By using cutouts with paste or glue you will attach them to a floor plan of your own design (from ideas gotten from the floor plans shown below) so that you create a garage design of your own which meets the needs of 1.)Efficiency 2.) Good use of available space and 3.) Most practical for purpose(s) intended. You can design it either for a collision shop, repair garage, service center, automobile dealership etc. Be inventive and use your imagination. Remember the outside shape of the building floor plan does not necessarily have to be only square or rectangular. When you are finished turn your work into the teacher for evaluation. You can also work in a team if you so desire. No more than two members should work together.

List of equipment and materials needed:

- ruler - 12"
- compass
- construction paper (colored)
- T square
- Triangle
- paper clips
- glue
- paste
- sheets of colored thin translucent plastic
- crayons
- pens
- colored pencils

Note: If any further materials or equipment needed see teacher.




LUBRICATION LIFT
TUNE UP
QUICK SERVICE
FRONT END
BRAKES
HEAVY REPAIRS
PARTS
WAITING ROOM

TIRE CHANGER

WHEEL BALANCER

DRUM LATHE

COMPRESSOR

ANALYZER

OVERHEAD REELS

BEFORE. .Plenty of floor space but inefficient layout. Stalls are poorly arranged, equipment placed hit or miss and space is wasted.

SHELVES

'SCOPE

PLUG CLEANER

BODY TOOLS

BENCH

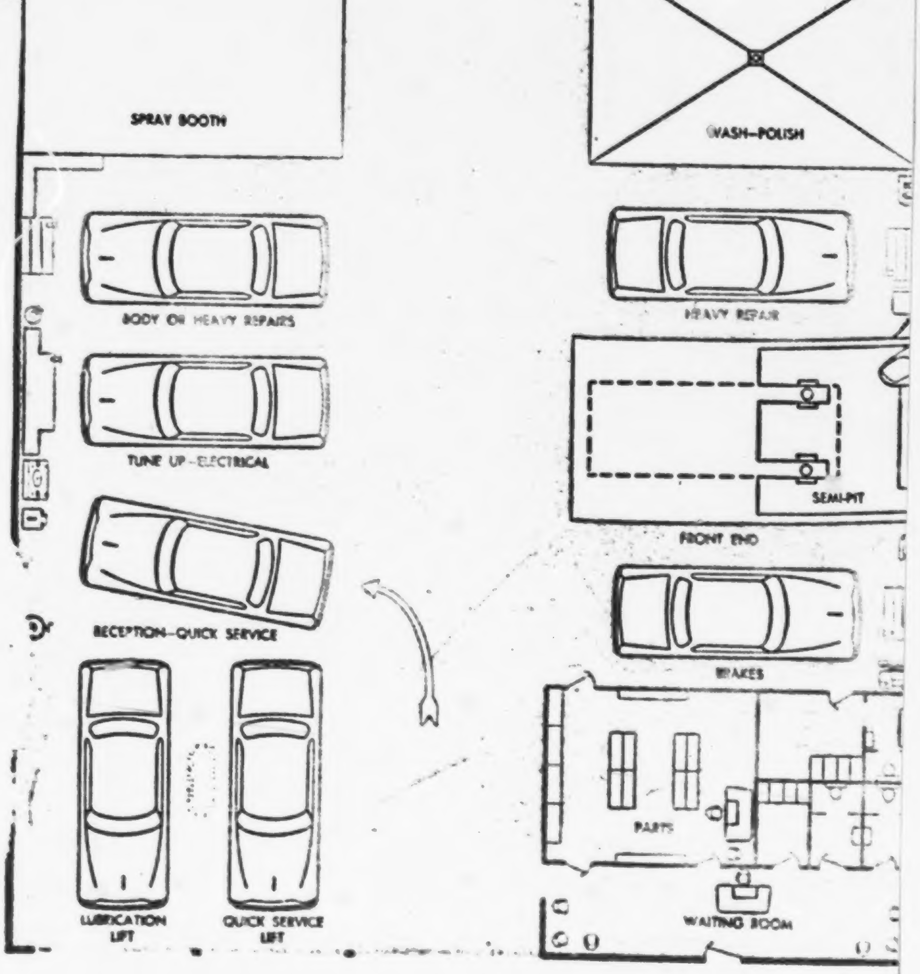
BENCH-CABINETS

CLEANING TANK

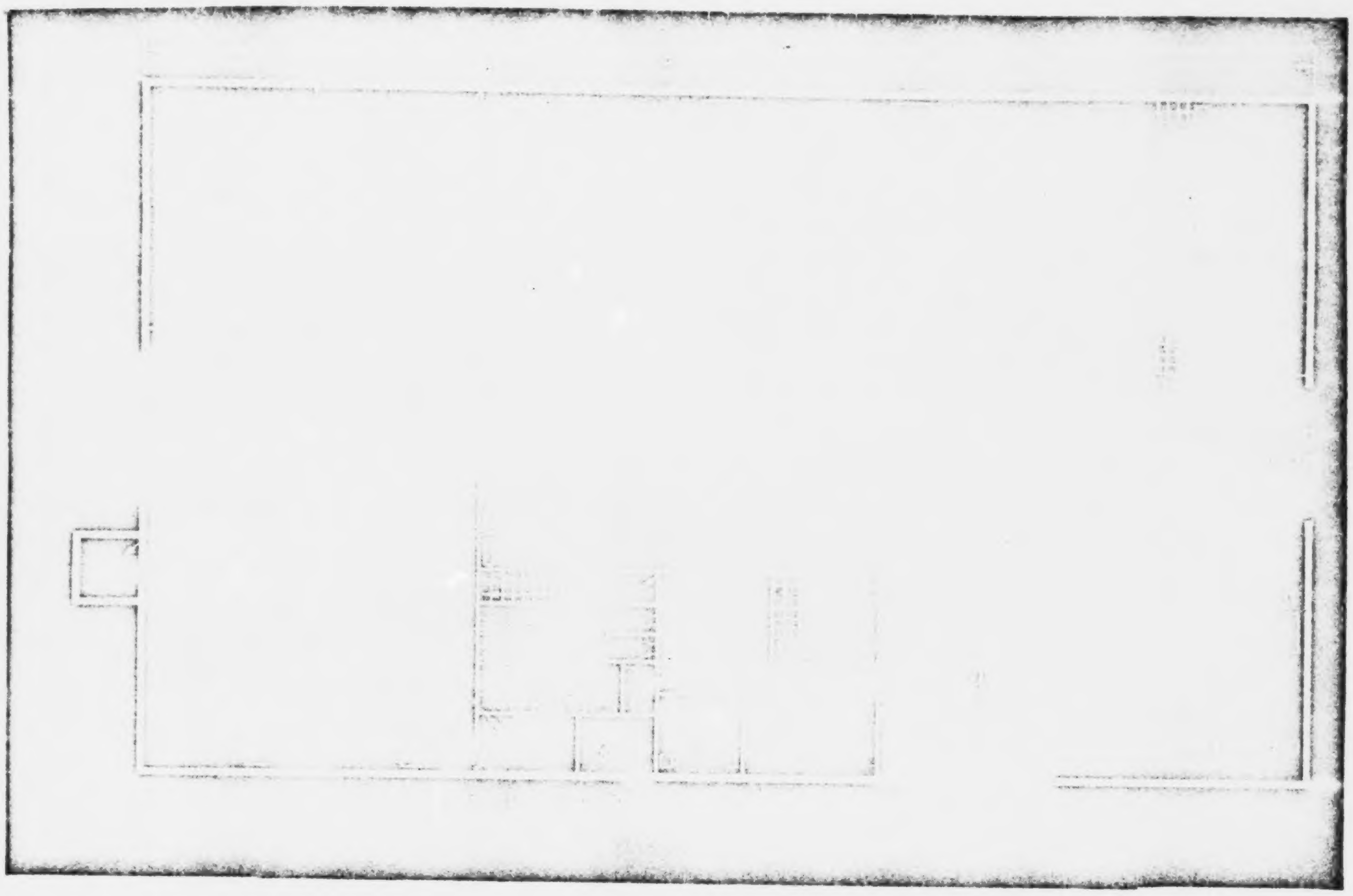
LOCKERS

CHAIR

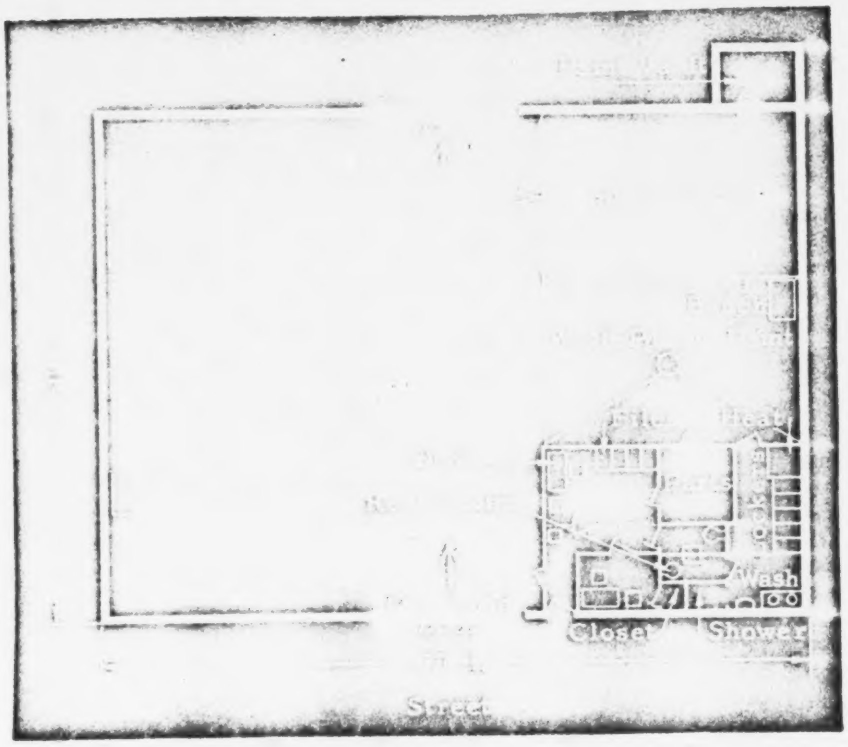
DESK


SPRAY BOOTH
WASH–POLISH
BODY OR HEAVY REPAIRS
HEAVY REPAIR
TUNE UP–ELECTRICAL
SEMI-PIT
FRONT END
RECEPTION–QUICK SERVICE
BRAKES
LUBRICATION LIFT
QUICK SERVICE LIFT
PARTS
WAITING ROOM

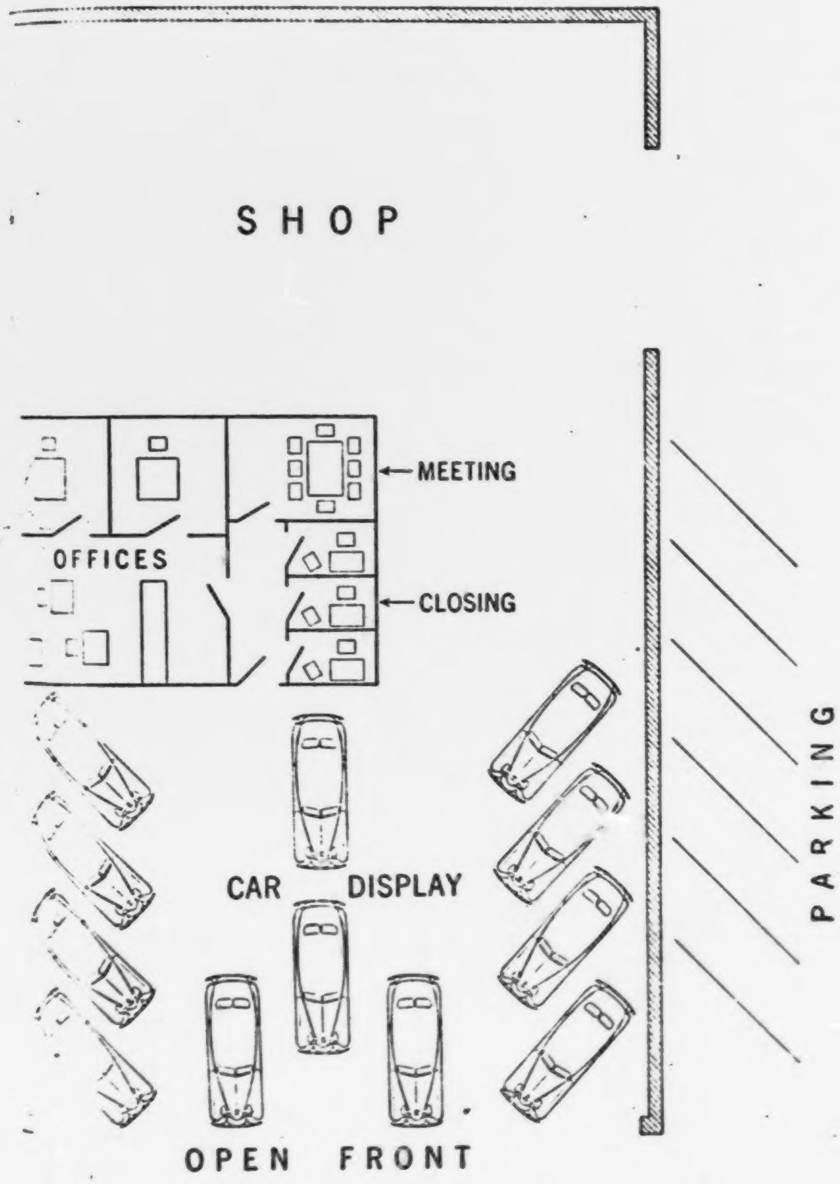
AFTER. .Here is the same size shop, rearranged for maximum use of space and top efficiency. Drawing shows how cutouts can be used to help replan



In this suggested plan for 15-car shop, full use is made of available space with equipment arranged for peak working efficiency


Wash
Closet
Shower
Street

Practical floor plan for small shop. Layout permits vehicles to be driven in and out of building easily


SHOP
MEETING
OFFICES
CLOSING
PARKING
CAR DISPLAY
OPEN FRONT

FOR THE STUDENT

SERVICE

COMPRESSION TESTING OF AN AUTOMOBILE ENGINE

Objective:

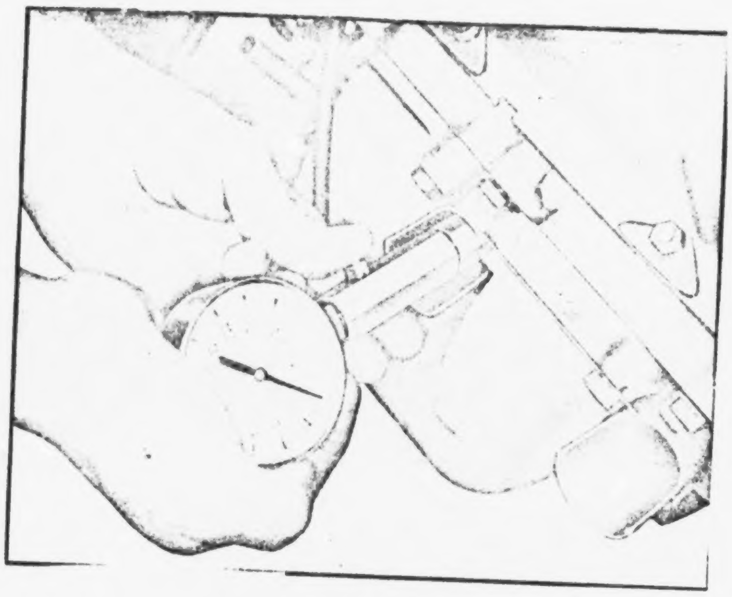
Given an automobile and the following list of materials, you will prepare the car for a compression test, perform the compression test, and record the results in the spaces provided on page 2.

1. Compression tester
2. Flexible compression testing hose (if needed)
3. Tire pump or compressed air supply
4. Spark plug wrench and handle or 13/16" deep recessed socket and rachet wrench (preferably ½ drive)
5. Pushbotton car starter switch (underhood attachment)
6. Squirt can of 20 weight engine oil
7. Clean shop cloth

Activity:

Prerequisite skills should include ability to use the tools listed above in the manner specified, and the ability to identify data on a compression gauge and record the figures (results.)

1. Remove any dirt or loose particles from around the spark plugs by blowing out plug area with compressed air using either tire pump or shop air supply. Grease or oil accumulation buildup around sparkplug can be removed by wiping firmly with clean shop cloth.
2. Loosen all sparkplugs one turn with wrench or socket and rachet.
3. Start engine and accelerate to a fast idle speed by pulling back throttle linkage of carburetor or have a partner step on accelerator pedal inside automobile. Here you can use your underhood starter switch if no one is available to assist you. This will blow out loosened carbon deposits inside combustion chamber.
4. Stop engine and remove sparkplugs. (Cleaning out carbon by this method will prevent false compression readings because of particles of carbon lodged under the valves.)
5. Now remove air cleaner assembly and block throttle and choke in a wide open position by inserting either a screwdriver or ½" wooden stick into the carburetor throat.
6. Insert the compression gauge firmly in the sparkplug opening (use flexible compression extension hose here - if necessary, some models of overhead valve V8 Engines.)



Checking Compression

7. Crank engine through at least 4 or 5 compression strokes. This is equal to starter turning over 4 or 5 revolutions, to obtain the highest possible reading on your compression testing gauge. Your gauge is calibrated from 0 to 150 or 200 lbs., compression depending upon the type and make of gauge. The needle will waver slightly when it is registering, but you will select the number for your reading which the needle points to when it has cranked over for the required number of revolutions.

8. Record the compression reading from your gauge for each cylinder - 6 readings for a 6 cyl. engine - 8 readings for an 8 cyl engine - etc. Record each cylinder reading under the correct cylinder number so you will be able to locate and ascertain which cylinder, if any, is the cause of low compression or cylinder leakage.

	Cylinder Number							
	1	2	3	4	5	6	7	8
1st reading	#	#	#	#	#	#	#	#
2nd if needed	#	#	#	#	#	#	#	#

9. Compression reading should read within the limits set or stated by the car manufacturer or any tune up chart in a car repair manual or major electrical automotive equipment manual. Also the variation between highest and lowest readings of the cylinders should be less than 20 lbs.

10. If one or more cylinders have a low reading, (less than manufacturer's specifications) squirt in about a tablespoon of 20 Wt. engine oil through the sparkplug hole, on top of the pistons in the low reading cylinders.

11. Crank over engine several times and recheck compression reading.

12. If compression is still low (does not reach normal compression check readings), it indicates worn piston rings.

13. If compression reading doesn't improve at all, valves sticking is the cause, or they are poorly seated.

14. If two cylinders, side by side, show low compression readings and squirting engine oil into the cylinder doesn't cause improvement, the cause might be a blown or leaking cylinder head gasket between the cylinders.

SERVICE

IGNITION BREAKER POINT REMOVAL AND REPLACEMENT-ADJUSTING CAM DWELL ANGLE

Objective:

Given an automobile, you will be able to install breaker points to the proper gap setting and cam dwell angle (dwell setting) without starting up the engine. The following materials and equipment will be provided.

1. Dwell meter
2. One set breaker points (ignition points)
3. Self starting starter solenoid unit
4. Ignition screwdriver
5. Regular straight blade screwdriver (long and thin blade prefered)
6. Chart or manual listing manufacturers' specifications (tune-up)

Activity:

Prerequisite skills should include ability to use simple hand tools and the ability to read a dwell meter and connect leads (alligator clips) to distributor from meter; and connect leads to starter solenoid.

Note: The first section applies to -- Fords(V8 and 6 cyl.) all years

Chrysler products -- (V8 and 6 cyl.) all years

American Motors -- (some V8 and all 6 cyl.) all years

General Motors products -- (all 6 cyl. and all V8 Pre 1956)

1. Take dwell meter and set meter selector switch to "Dwell Calibration". See Figure 1.

Dwell Meter

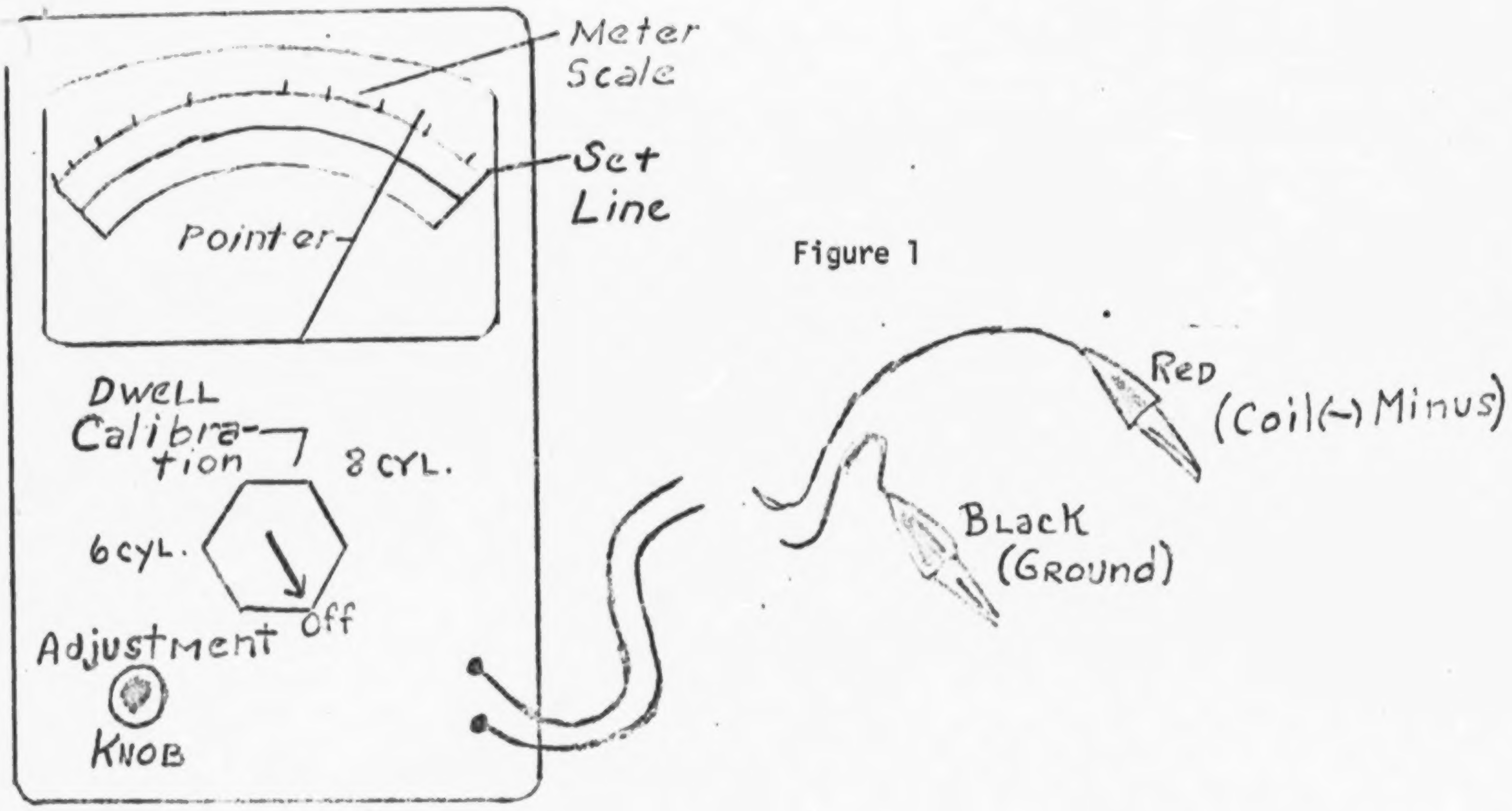

Meter Scale
Set Line
Pointer
Dwell Calibration
8 CYL.
6 CYL.
Off
Adjustment Knob
Red (Coil(-) Minus)
Black (Ground)

Figure 1

2. Now adjust meter to "Set Line" by turning adjustment knob so needle rests directly on set line (angled vertical line) at far right on meter gauge face.

3. Switch meter control knob to number of lobes on distributor shaft - 8 cyl. - 8 lobes, 6 cyl. - 6 lobes, etc.

4. Remove distributor cap, coil wire, rotor. See Figure 2.

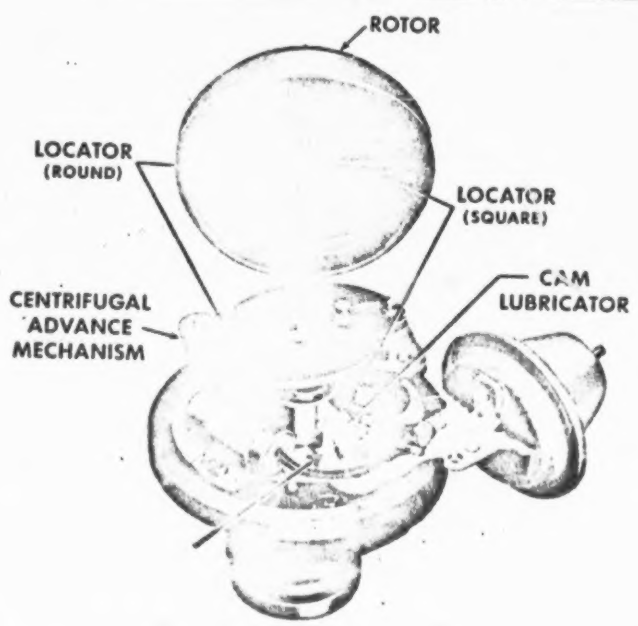

ROTOR
LOCATOR (ROUND)
LOCATOR (SQUARE)
CENTRIFUGAL ADVANCE MECHANISM
CAM LUBRICATOR

Figure 2

Top View of Distributor

5. Connect Black lead of meter to suitable ground (such as carburetor air cleaner hold-down bolt).

6. Connect Red lead to Minus (-) side or secondary ignition side of ignition coil.

7. Refer to manufacturers' specifications in determining amount of degrees to set points at.

8 cyl. usually 26° - 32°

6 cyl. " 28° - 35° Dwell Angle

4 cyl. " 32° - 90°

8. Loosen point hold down screws (2 screws), with ignition point screwdriver. See Figures 3 and 4.

Figure 3

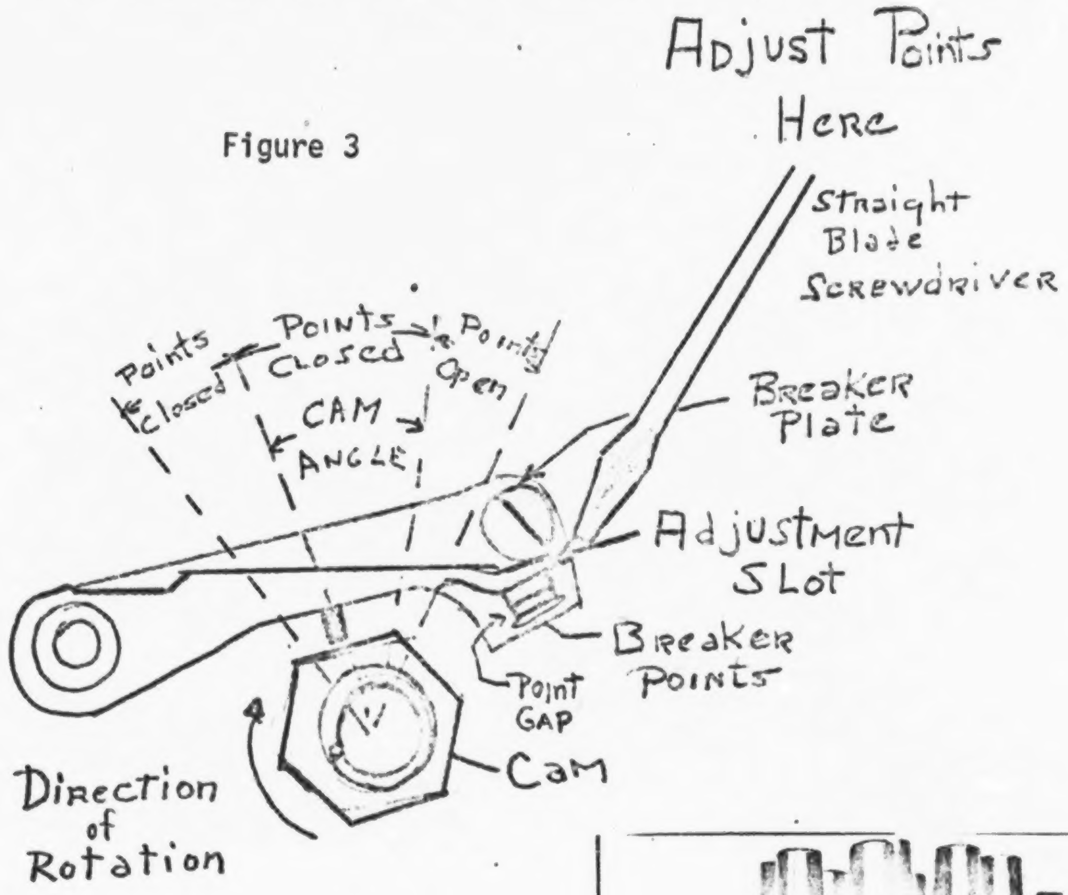
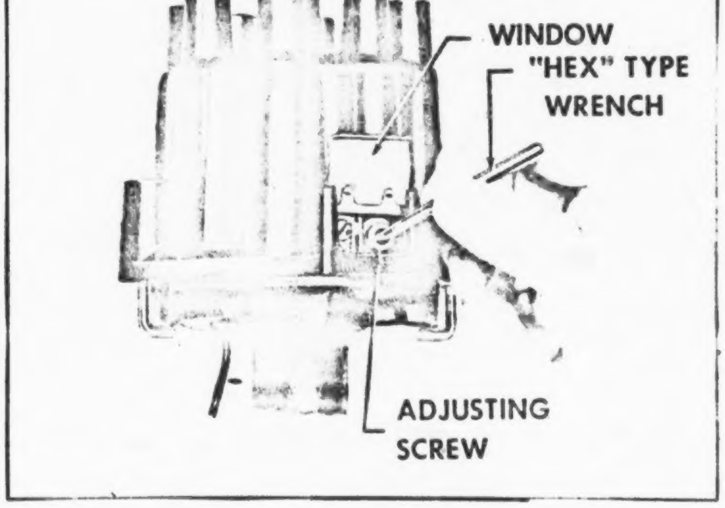

Adjust Points Here
Straight Blade Screwdriver
Points Closed
Points Closed
Points Open
CAM ANGLE
Breaker Plate
Adjustment Slot
Breaker Points
Point Gap
Cam
Direction of Rotation

Figure 4


WINDOW
"HEX" TYPE WRENCH
ADJUSTING SCREW

Setting Point Dwell

FOR THE STUDENT

SERVICE

BREAKING CYLINDER WALL GLAZE AND CLEAN-UP PROCEDURE

Objective:

Given an automobile engine, you will be able to deglaze a cylinder wall and use a clean-up procedure that will leave cylinder block free of any abrasive material. You will be provided with the following tools and materials:

1. Cylinder hone or flexible deglazing tool
2. Clean SAE 10 oil
3. Supply of clean rags
4. Electric drill ½"chuck

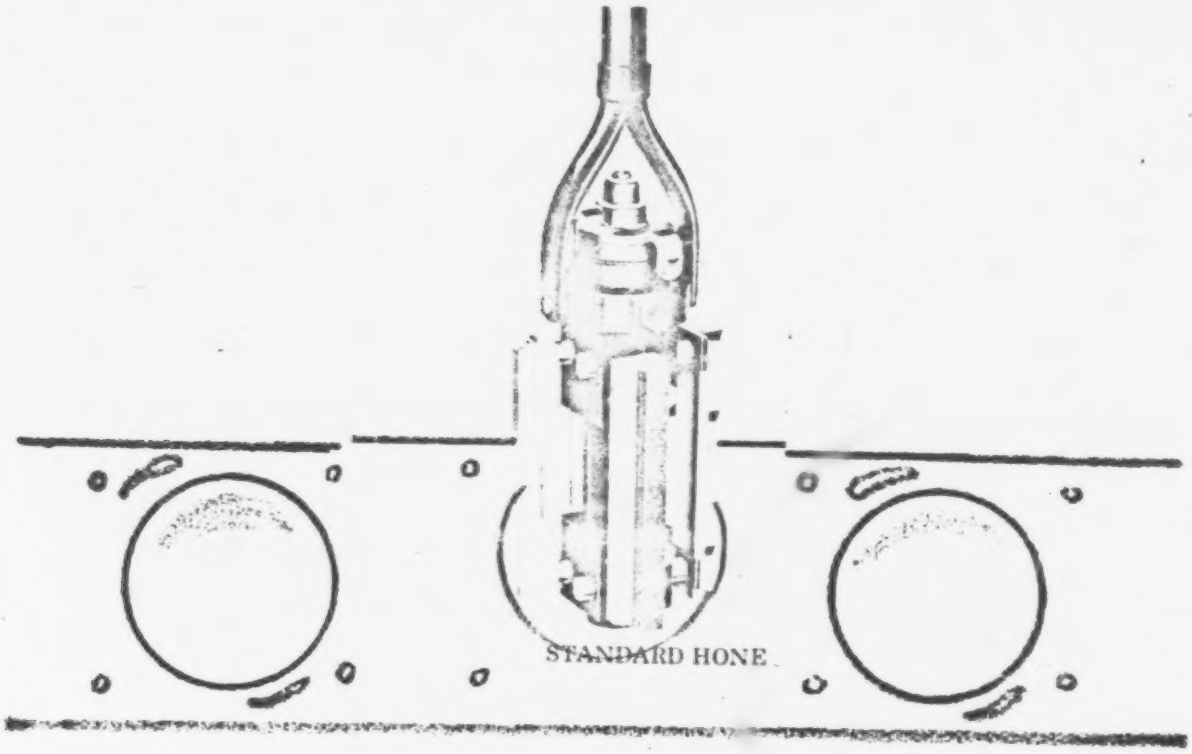
Activity:

Prerequisite skills should include ability to use a cylinder hone or flexible deglazing tool and follow the steps below to deglaze a cylinder and clean up abrasive material afterwards.

1. Carefully pack the bottom of the cylinder bore with clean rags to prevent the abrasives and dirt caused by honing from falling onto the crankshaft

2. Dip a clean cloth in clean SAE 10 oil and swab the cylinder wall thoroughly.

3. Install the cylinder hone in the top of the cylinder wall until it makes contact with the wall and is in straight. (Use a regular cylinder hone with stones of from 180 to 280 grit to produce the desired surface finish of 15 to 30 micro-inches,as shown in picture below).



4. Oil stones also and connect shank of hone to drill chuck, tighten firmly.

5. Surface hone the cylinder from 10 to 12 complete strokes. (From top to bottom of cylinder is a complete stroke.) When honing move the hone rapidly up and down in the cylinder to obtain a pattern of crosshatching of 30 to 45 degrees. See illustration below.

You obtain a crosshatch pattern of 30 to 45 degrees,as shown, by using clean, sharp 180 to 280 grit stones.

6. Clean loose abrasive material from the hone with a cloth before placing hone in another cylinder.

Cylinder Cleaning

7. Using a clean cloth wipe as much of the abrasive deposits from the cylinder wall as possible.

8. Now swab out the abrasive-coated cylinder and crankcase with clean 10 SAE oil. ONE SWABBING AND WIPING IS NOT SUFFICIENT. Usually three such operations are necessary, but more may be required. The test is to continue cleaning until a clean white rag shows no sign of dirt or discoloration when wiped through the cylinder bore.
Note: Never use gasoline, kerosene or any commercial solvents to clean a cylinder after honing because solvents of this type will not remove abrasives from the wall,and rapid engine wear and ring failure will result from failure to properly clean the abrasive from the cylinder.

FOR THE STUDENT

No. H 22

SERVICE

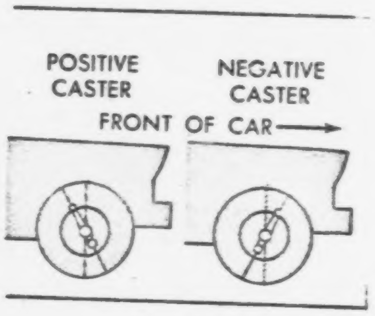
WHEEL ALIGNMENT CORRECTION

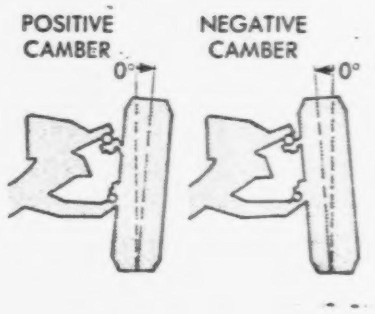
Objective:

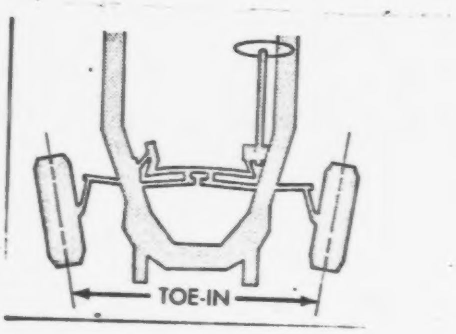
Given the following pictures, you will state the five types of angles designed into the automobile suspension system.

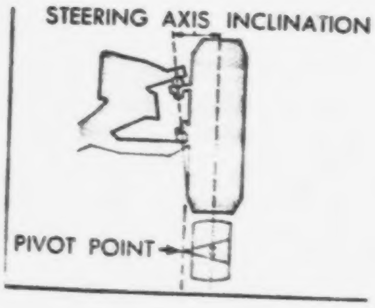
Activity:

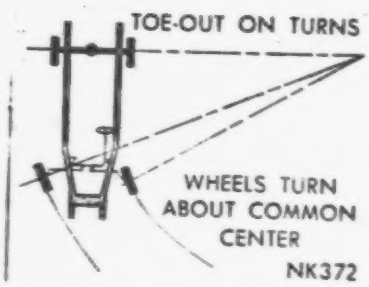
1. Look at the five drawings illustrating caster, camber, toe-in, steering axis inclination, and toe-out: 2. Study these until you can identify each type of angle without looking at the name. 3. Go to the teacher who will test you with the five drawings showing the same angles. You will be expected to identify them all correctly. Be sure to understand the direction in which each angles alignment lies.


POSITIVE CASTER
NEGATIVE CASTER
FRONT OF CAR


POSITIVE CAMBER
0°
NEGATIVE CAMBER
0°




STEERING AXIS INCLINATION
PIVOT POINT


TOE-OUT ON TURNS
WHEELS TURN ABOUT COMMON CENTER
NK372

TEACHER PACKAGE   No. H 23

SERVICE

PLUMBING

USE OF COPPER TUBING AND FITTINGS TO DEMONSTRATE INDUSTRIAL USES

Objective:

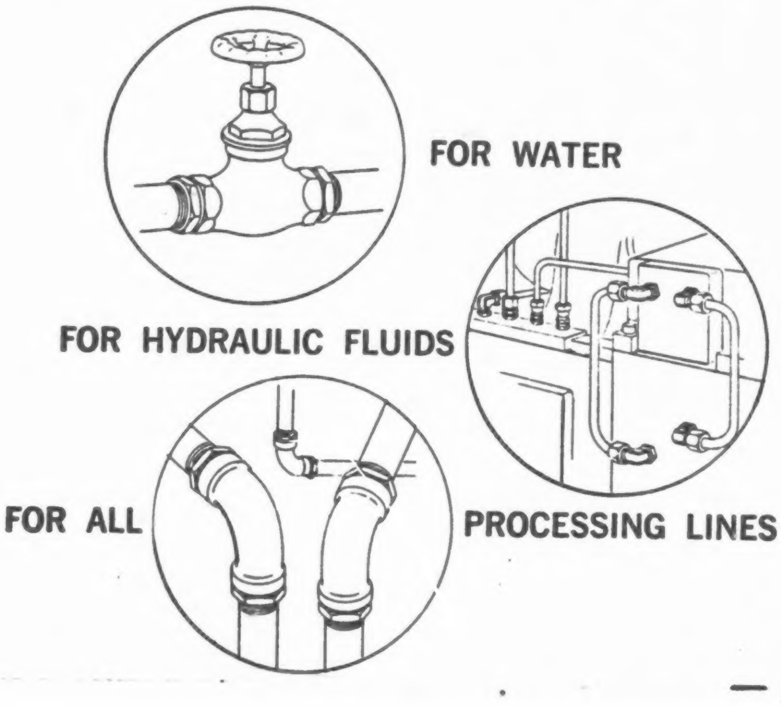
The student will construct a 6" copper, 3/8" diameter, to within ± 1/32" in length to help demonstrate the close tolerances needed in industrial operations for tubing and fittings to be useful and have utility. The student will study the chart below and select one of the three applications as the one he wants to reproduce. The teacher should reproduce the chart to a larger size and either place on the bulletin board or have a central location for the student to be able to have access to.

Activity:

The student should have read and passed the post test on hand tool packages dealing with the tube cutter, its use and functions and the use of the flaring tool, packages No.'s H 31, H 32, and H 33. Have a supply of copper tubing (3/8" O.D.) and tube cutters along with a supply of fittings available for the students to practice with. Have the picture enlarged and reproduced to a larger size chart so they can become aware of the possibilities of the different uses for tubing combined with fittings in the plumbing industry.

Post test:

Have the students identify three uses for fittings on copper tubing in industry after they successfully complete cutting a copper tube with fitting to the size stated above.



FOR THE STUDENT

No.H 24

SERVICE

FUEL PUMP REMOVAL AND REPLACEMENT

Objective:

You will be able to remove and replace a fuel pump, given the following tools and materials.

1. New Fuel pump
2. Fuel pump base gasket
3. Socket wrench (rachet drive) 3/8" or ½" drive
4. ½" or 9/16" Deep socket
5. Socket extension 4" to 6" length
6. Scraper
7. ½" and 9/16" open end wrench
8. Wire hose clamp pliers (optional)
9. Can of penetrating oil
10. Fuel filter (optional)

Activity:

1. Get the tools and materials and take them to your work station.
2. First loosen fuel lines from fuel pump. You will probably only use your ½" or 9/16" open end wrenches to loosen the fittings on the fuel lines. If nuts are tight or rusty use penetrating oil first. Some cars have a rubber fuel line attached with a clamp leading to the carburetor, on these you use your hose clamp pliers.
   Note:If the filter is attached to this line and the car has 24,000 miles or more on it,it is recommended procedure to replace the filter because it will only add contaminants to the fuel system and might cause damage to the carburetor.
3. Remove the bolts holding the fuel pump to the engine block, with your socket wrench, sockets, and extension.
4. Pull fuel pump out gently so pump rocker arm can clear the opening.
5. Inspect pump for any fittings that should be attached to new pump before reinstallation. Always check rocker arm to make sure it is the right length and type.
   Note: Some pumps will fit on cars but not make proper contact with the camshaft. Before reinstallation check rocker arm and camshaft for any wear.

6. Scrape off old gasket and replace with new gasket. A little grease will help hold gasket in place if it slides out of position while reinstalling fuel pump.

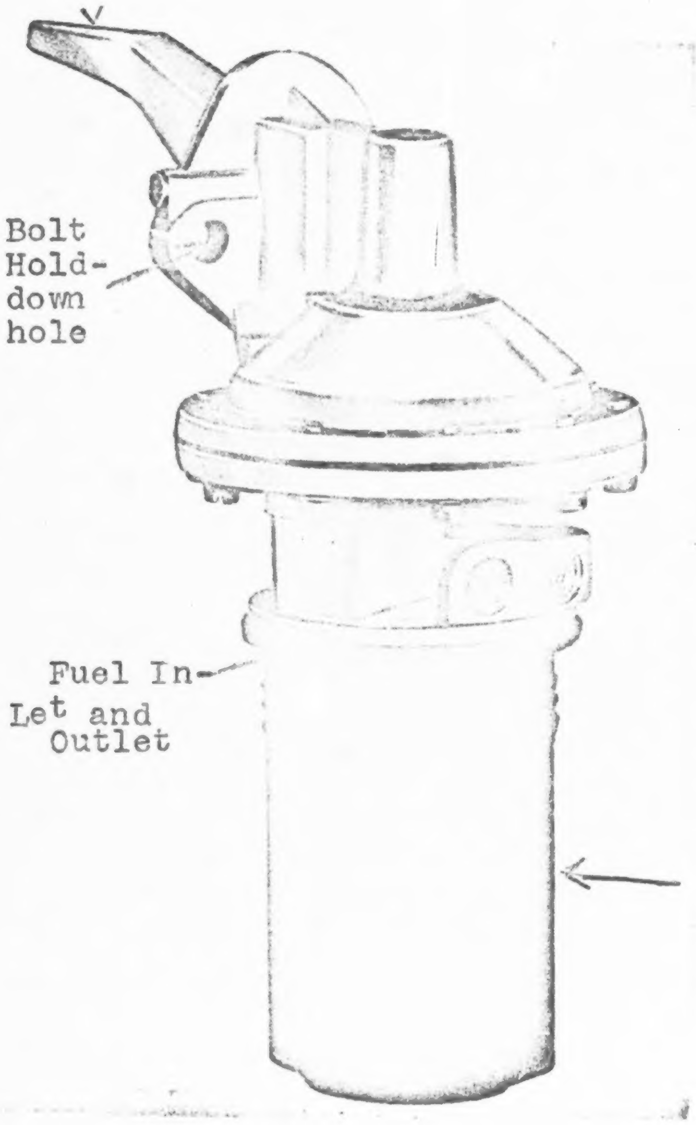
7. Check holding bolt threads for any wear or stripping. If bad or worn, replace.

8. Slide new fuel pump into position, taking care to make good contact with camshaft by fuel pump rocker arm. Note: Pumps must always go back in the position that they are removed. Some pumps look like they are upside down when in position, but it only means they are designed so the camshaft will strike the correct side of the rocker arm when revolving.

9. Tighten up holding bolts and secure fuel lines fittings to the fuel pump body. DO NOT OVERTIGHTEN, because the body of a fuel pump is made out of a cast type metal (pot metal) and will break if to much pressure is applied. A good way to check this is to install lock washers behind the head of the bolts, and when they flatten out, or any grease left on the gasket squeezes out it means the pump is securely in place.

10. Now start the automobile, by first pumping the accelerator a few times to draw gas up from the fuel tank, and running for five minutes warm up time. Check your fittings for any leakage if loose, stop engine and retighten. Check engine and carburetor for proper running order - does it idle properly and is it receiving the proper amount of gas at high speed.

11. Have the teacher or foreman check your job.


Rocker Arm
(Contact Surface)
1.
Bolt
Hold-
down
hole
Fuel In-
Let and
Outlet
Fuel Filter
(attached type)

Wear Surface
Rocker Arm

FOR THE STUDENT

SERVICE

STARTER FREE-RUNNING TORQUE TEST

Objective:

Given an automobile starter (12 Volt) you will test it for determining whether starter meets factory's current and speed specifications. You will be given the following tools and equipment:

1. 12 Volt battery
2. Ammeter
3. Voltmeter
4. Starter craking motor with solenoid (mounted)
5. R.P.M. Indicator
6. Jumper Lead
7. 2 Batter Cables
8. 3 Connector Leads
9. Vise

Activity:

Given the above equipment and tools follow the steps listed to make a free-running torque test of the starter to help determine if it is running at the correct speed and if it is in need of repair.

1. Clamp the starter in a bench vise to hold it firmly during the test.

2. Connect an ammeter and its shunt of sufficient capacity (300 to 500 amp) as shown in diagram, in series with the starter terminal.

3. Ground the starter frame to the ground on a fully charged battery.

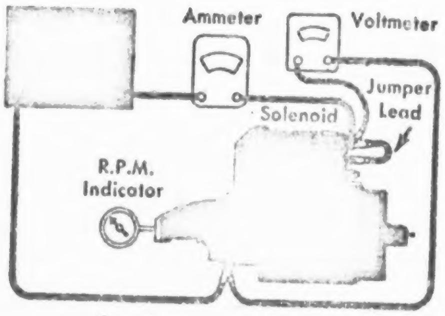
4. Connect a voltmeter from the starter terminal to the ground.

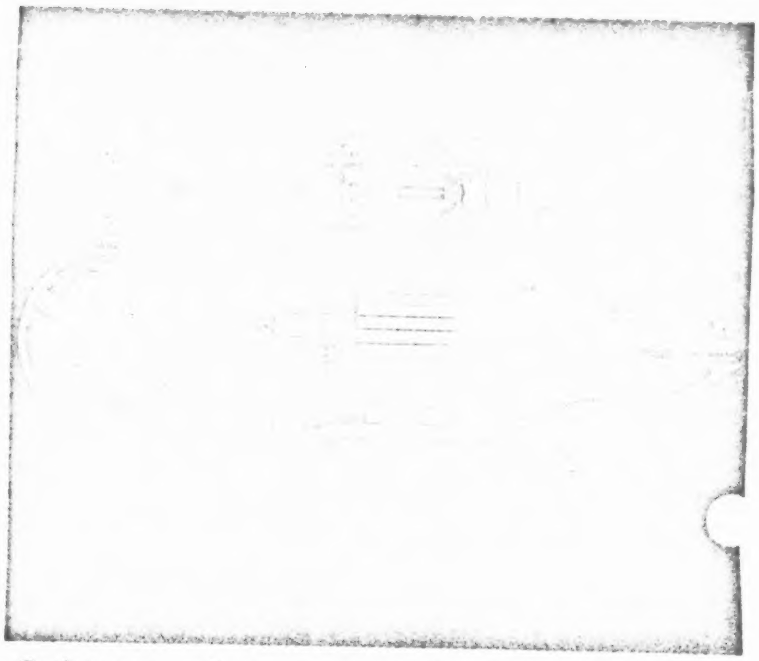
5. Connect a jumper lead between the starter pole on the solenoid and the battery pole of the solenoid.

6. When the lead is connected it will operate the starter switch and the starter will run free.

7. Its speed can be read by placing a mechanical speed counter (R.P.M. Indicator) against the armature shaft (fron nose cone of starter) as it turns.

8. Record the results. Consult manufacturer's specifications for free-running specifications to determine if starter is running at correct speed.


Ammeter
Voltmeter
Jumper Lead
Solenoid
R.P.M. Indicator



Cutaway of a conventional automotive electrical starter motor. Shows solenoid-operated switch and overrun clutch.

FOR THE STUDENT No. H 26

SERVICE

PREPARING REPAIR ORDERS

Objective:

Given paper ($8\frac{1}{2}$ X 11) and examples of repair orders, you will make up your own repair forms.

Activity:

Compare the different forms you have and decide which categories, descriptions, separate sections, etc. you must have, and what information and additional data you must include on your form to make it complete.

To design your repair order form you must have the following material:

1. Paper-unlined
2. Sissors
3. Paste
4. Ruler
5. T-square (if possible)
6. Blue ink pen
7. Red ink pen
8. Lettering guide
9. Dictionary of mechanical terms

1. Examine these forms and decide which categories and sections would be applicable for your use. For example; if you are developing an automotive form you should have a section for parts used, a section for accessories; a section for grease and oil; and instructions for repair. For machine repair, you would use sections such as; labor record; sublet repairs to other departments; machine description; and record; etc.

2. When you have decided which sections are applicable, you can cut them out from the attached sample forms and paste them on your paper where they should go. Other sections or information that you wish to include can be drawn, lettered, or lined on the open sections of your sheet.

3. Decide on a final layout, and arrange your cutout sections carefully on your paper. When they are in the position you desire, paste them in place.

4. If you are not pleased with the appearance or function of your order form, try again on another sheet of paper.

5. Show the completed form to your teacher.

FORM HO-777

THE REYNOLDS & REYNOLDS CO. DAYTON, OHIO LITHO IN U.S.A.

[illegible] Mercury, Inc.

BODY SHOP

QUAN.	PART NO. & DESCRIPTION	PRICE
1	C7my13439B Door	13 85
1	C7my13451A Lens	4 70
		18 55
	Disc 15%	2 77
		15 78

Ret'd [illegible]

SUBLET REPAIRS

TOTAL

DATE 2-2-70

NAME J. Canch

ADDRESS 23541 [illegible]

CITY Oak Park

PHONE RES. 543-4969

PHONE BUS.

YEAR	MAKE	MODEL
67	Merc	Monterey 2DR HT

LICENSE NO.	SPEEDOMETER	ORDER NO.	WRITTEN BY
HA1089			

CODE OR I.D. NO.

INSURANCE COMPANY

ADDRESS

CUSTOMER PAYS →

ADJUSTOR

INS. CO. PAYS →

	INSTRUCTIONS	LABOR
	[illegible] Rear Bumper	[illegible]
	[illegible] up [illegible] [illegible] Lens 4 Door	[illegible]
	Bump up Qtr Panel	28 [illegible]
	Painting	22 00

I hereby authorize the above repair work to be done along with the necessary material [illegible]

AUTHORIZED BY:

X [illegible]

NOT RESPONSIBLE FOR LOSS OR DAMAGE TO CARS OR ARTICLES LEFT IN CARS IN CASE OF FIRE, THEFT OR ANY OTHER CAUSE BEYOND OUR CONTROL.

SECURE RELEASE FOR

INVOICE TO

ADDRESS

LABOR	
PARTS	
PAINT MATERIAL	[illegible]
SUBLET REPAIRS	
TOWING	
TAX	
TOTAL	94 [illegible]

FOR THE STUDENT

No. H-30

SERVICE

THE PLUMBER - THREADING PIPE

Objective:

Given pipe, proper size dies, guide bushing, file and cutting oil, you will thread a pipe.

Activity:

1. Get pipe and threading kit from supply room.

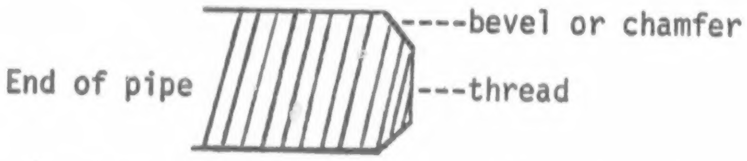
   List of materials include:

   1. Pipe section
   2. Threading dies (depending upon size pipe)
   3. Guide bushing
   4. File (metal)
   5. Can cutting oil

   You must have access to a pipe vise to properly hold the pipe while threading.

2. Select the proper dies and guide bushingfor the size of pipe to be threaded.

3. Place the pipe in the pipe vise, and file a slight bevel or chamfer on the end of the pipe for easy starting.



4. Squirt a generous amount of cutting oil over the die and start the thread by turning the stock slowly in a clockwise direction, keeping the die pressed firmly against the pipe.

5. After the die has "caught" on the pipe, continue turning the stock, backing it off about one quarter turn after every half turn, in order to break off chips. Continue to apply cutting oil.

6. To determine the correct length of thread, take a pipe fitting and screw it onto the thread being cut. Refer to the Table below to find the length of pipe thread which should be engaged in the fitting.

Size of Pipe	Dimension A (For 90^0 "L" "Tee" or Street "L")
1/2"	5/8"
3/4"	13/16"
1"	7/8"
1 1/4"	11/8"
1 1/2"	15/16"
2"	1 9/16"

7. Examine the thread for defects such as, being chipped, roughness, flatness, and not completely cut to size. Chipped threads are often the result of a dull cutter, which should be replaced. If they are rough, flat, or not completely cut, be sure to go over them again with the die threader to correct these faults.

8. When completed, cut to size, and checked with a pipe fitting, take to the teacher for inspection and final check of your work.

Additional required information:

In order to start the die as squarely as possible, a guide bushing is provided for each size of pipe. This bushing fits over the outside of the pipe and helps to start the die straight.

Pipe and pipe fittings are threaded with the American Standard pipe thread.

FOR THE STUDENT

No. H 3-1

SERVICE

THE PLUMBER

PREPARING TUBING FOR FITTINGS

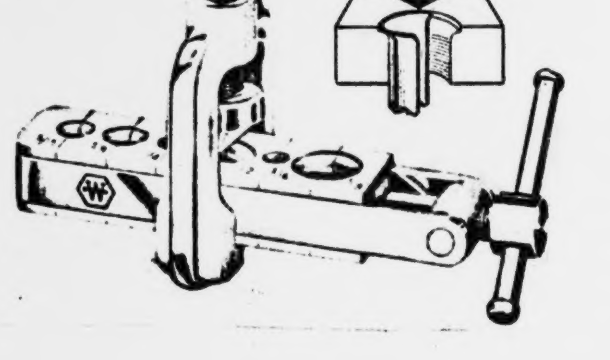
Objective:

Given thin walled copper tubing, fittings, a flaring tool, a file, and emery cloth, you will flare copper tubing and install the proper size and type fittings.

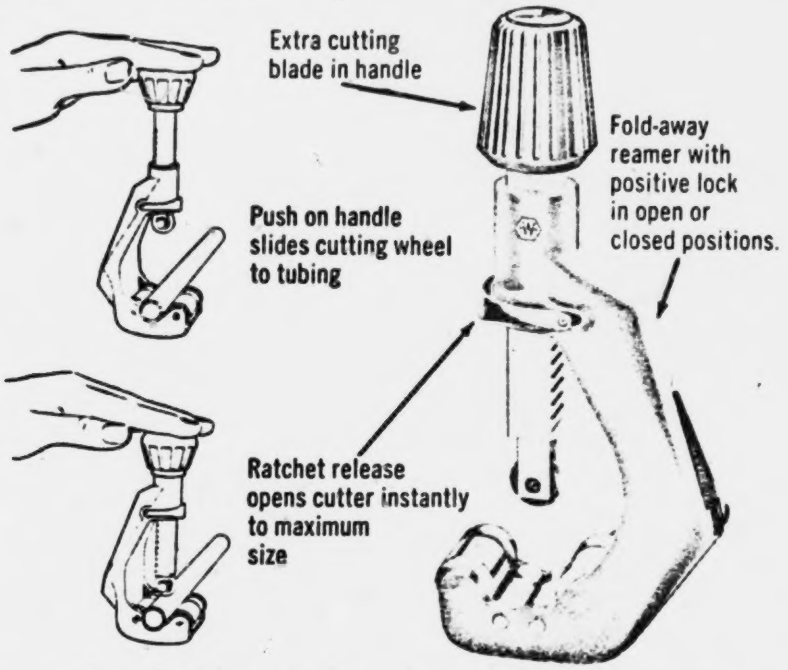
Activity:

Prerequisite skills of using a flaring tool, tube cutter, and measurement along with the use of simple hand tools, the file and reamer, will be needed. If you need more practice or are not proficient in the use of these tools, check the packages on the use of tools and simple hand tools. Also your instructor will be able to provide you with further activity and use of tools which will enable you to successfully complete this package.

1. Get required tools and supplies from your supply room. These tools and materials should include:
   1. Piece of copper tubing approximately 12" long
   2. Three bottles(Preferably baby food size jars) of fittings(You must make a choice between these and select the proper fitting for the tubing)
   3. Flaring tool;usually of the two-piece model, which includes a base and a flaring tool
   4. Sheet of emery cloth
   5. File
   6. (Optional)Reamer if none included with flaring tool
   7. Sizing Tool(Optional)
2. Make sure that the copper tube ends are cut square. If not, recut tubing with tube cutter to square it. Check squareness by sighting it,in proper size hole in base of flaring tool. See illustration below.

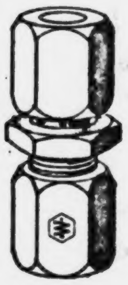


3. If there are any burrs on the cut end, remove them with the reamer, which is usually found on the end or side of the tube cutter. A file can also be used instead of the reamer. Any burrs on the outside of the tube are removed with light strokes of a file.


Extra cutting blade in handle
Fold-away reamer with positive lock in open or closed positions.
Push on handle slides cutting wheel to tubing
Ratchet release opens cutter instantly to maximum size

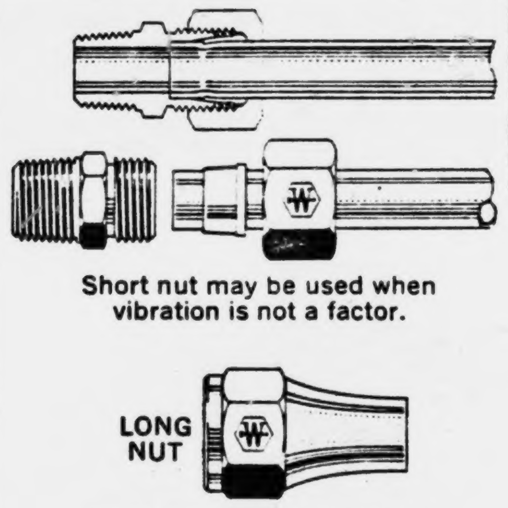
4. If the end of the tube is out-of-round, due to handling, a sizing tool is used to restore it to its original size and shape. This can also be done with most flaring tool bases which are calibrated to size. Select the correct size depending upon the size of the tube, insert into the base, clamp shut, and then bend gently to right or left to bring tubing to a straight position.

LARGE HEX UNION



5. Prior to flaring select the correct fittings from the 3 jars (these will include flared type, non-flared type, and hex union type, and you should select the proper type for the job. Study the types pictured below for proper identification.

FLARELESS FITTINGS

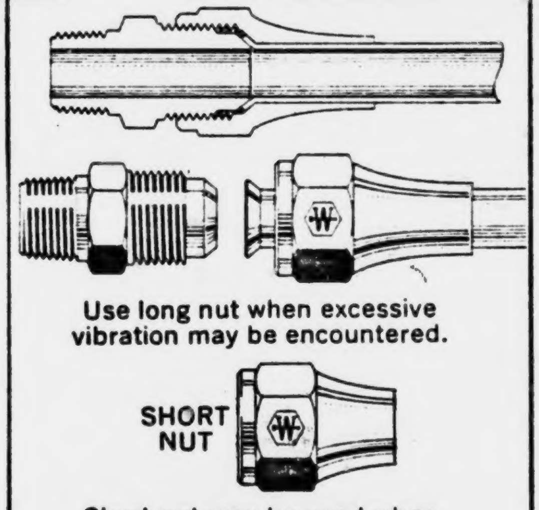


Short nut may be used when vibration is not a factor.

Use long nut when excessive vibration may be encountered.

SELF-ALIGN

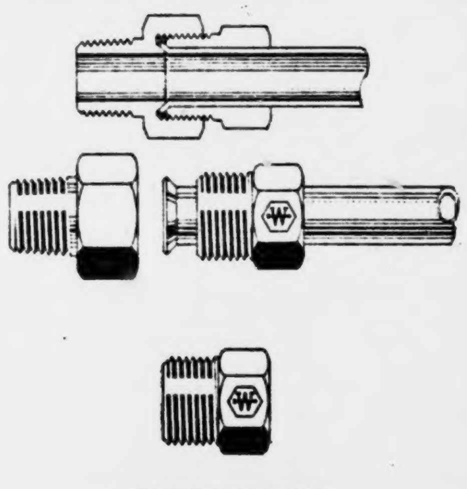
FLARED FITTINGS



Use long nut when excessive vibration may be encountered.

Short nut may be used when vibration is not a factor.

SAE 45° FLARED



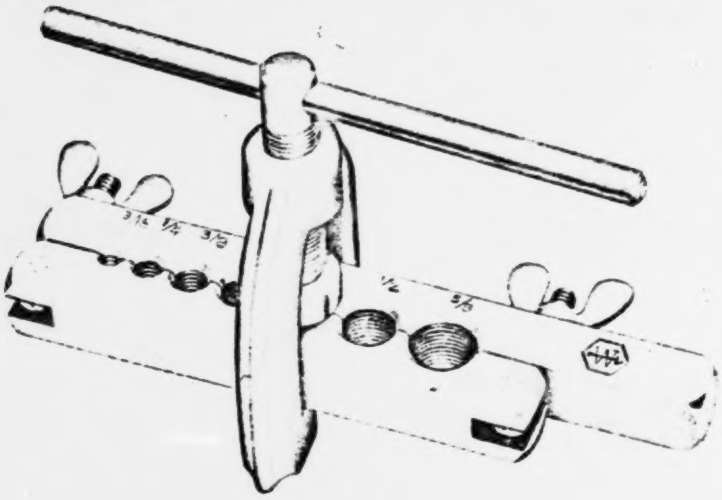
STANDARD NUT
Available in Brass or Steel

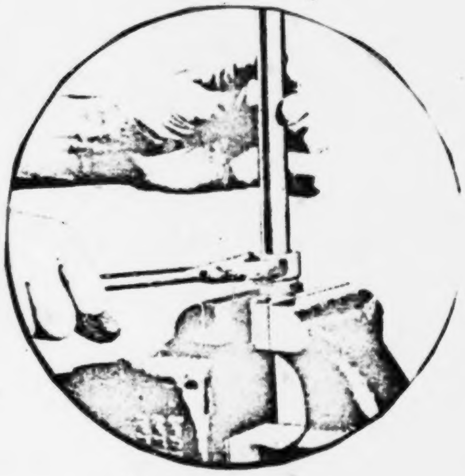
INVERTED FLARED

6. When you have made the proper selection and had them verified by your teacher, prepare the outside surface of the tubing for the fittings by sanding with emory cloth to insure complete smoothness of finish.

7. Insert the copper tube into the proper size hole corresponding to the size of the tubing (dia.size), and clamp firmly. There should be no slack and the tubing should be held firmly in place with the tubing flush with the top of the flaring base. Refer also to illustration on first page of package.

8. Now place the flaring tool over the tube and adjust so the flaring tip is down into the inside of the tube. To insure a perfect fit, it is important that the flanging tool be kept centered in the end of the copper tube. If this is not done the flare will be off-centered or lop-sided.



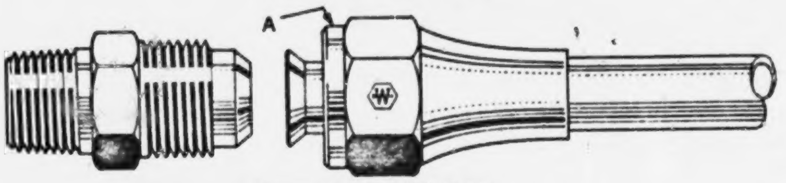


9. Hold the base tightly in your hand or if possible in a vise so that it won't slip while flaring. Turn the handle of the flaring tool clockwise for tightening. At this point be sure to check the height of the tube once again, to insure that it isn't to high for the flare to be made. If it is, be sure to lower it because the result would be a flare that will split because it is to thin. If need be refer again to illustration on first page of package.

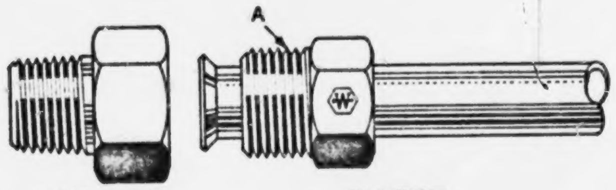
10. Once the flare has been made slip the male fitting on the tube from the opposite direction and compare how the flare fits in the fitting and does it seat properly. If not repeat the flaring operation again. Now before starting the second flare slip on the other fitting, reverse side, since once the flare has been made there will be no other way besides cutting the tubing to have it installed.

FLARED FITTINGS

ASSEMBLY INSTRUCTIONS FOR SAE 45° AND INVERTED FLARED FITTINGS



SAE 45° FLARED



INVERTED FLARED

11. Repeat the flaring for the other side of the tube. Again compare flare with fitting. If it seats properly you can now recheck the copper tube for straightness and evenness.

12. When completed and satisfied the job is correctly done, take to the teacher for final inspection.

FOR THE STUDENT

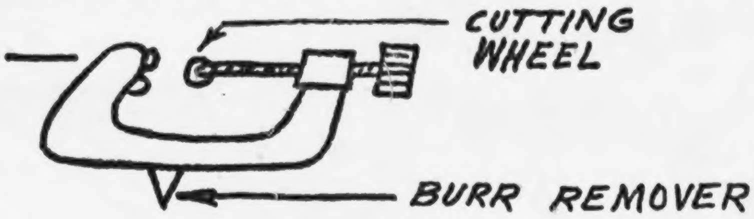
SERVICE

REPAIR OR REPLACEMENT OF METAL TUBING USING A FLARE FITTING

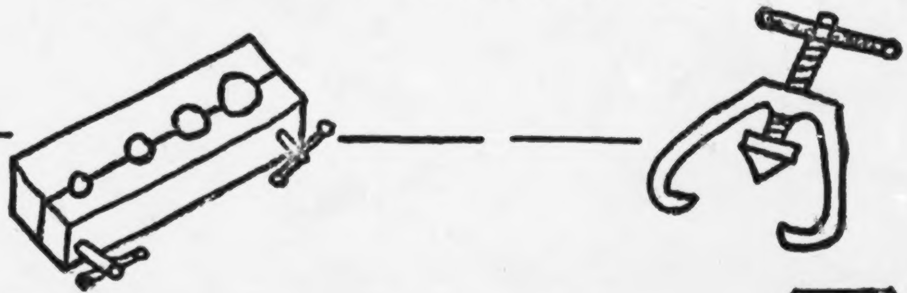
Objective:

You will be able to replace and/or repair metal tubing using a flare fitting, when given the following tools and materials.

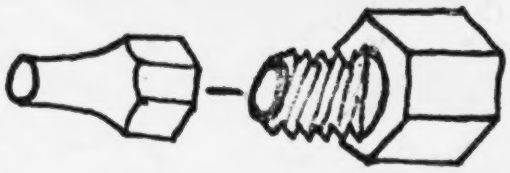
1. Tubing cutter



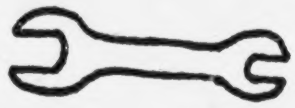
2. 2" piece of copper tubing
3. A flaring tool (2 parts)



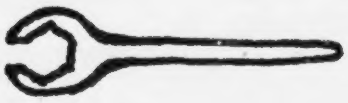
4. Flare fitting



5. Set of wrenches
   open end wrench
   or



   tubing wrench

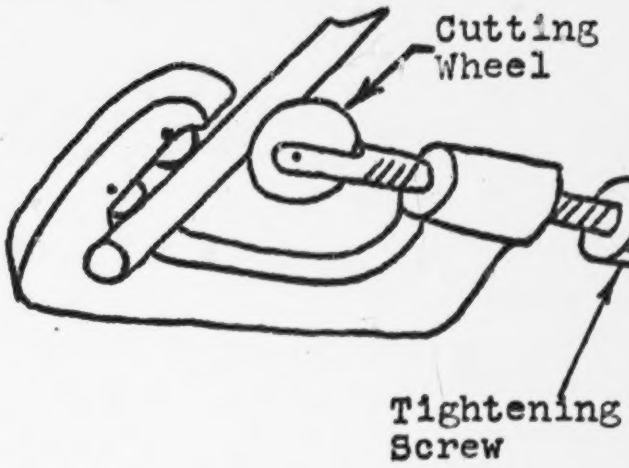


6. A ruler
7. A sample of a completed flare fitting

Activity:

Get the sample flare fitting, look it over carefully and follow steps 1 through 10 to make the tubing connection.

1. Get the tools and materials listed above and take them to your work station.



2. Using the tubing cutter, follow the steps to cut off a piece of copper tube about 2" long. Locate the cutting wheel 2" from the end of the tube and tighten the cutting wheel so that it just touches the tube as shown in the picture.

   (A) Now hold the tubing and rotate the tubing cutter one full turn.

   (B) Tighten the tubing cutter screw about 1/4 turn after each full turn of the tubing cutter.

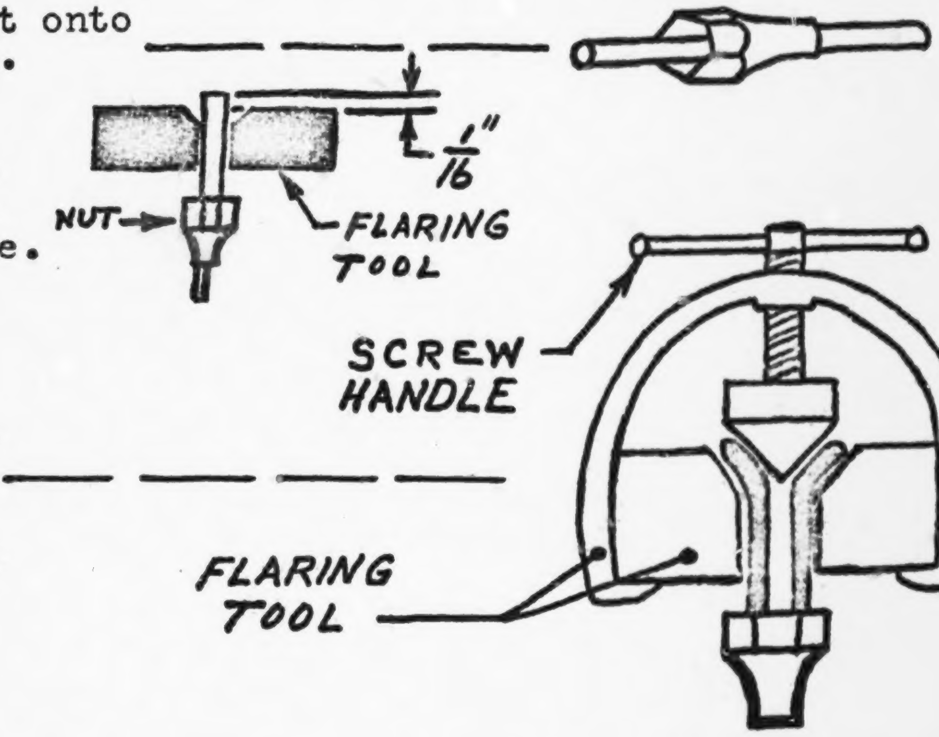
   (C) Repeat steps (A) and (B) until the tubing is cut into two pieces.

3. Look at the inside of the tube. You will notice a burr. This burr must be removed with the burr remover tool attachment on the back of the tubing cutter. Remove the burr by rotating the tool inside the tubing cutter.

4. Slide the female nut onto the tubing as shown.

5. Place the tube into the flaring tool as shown in the picture.

6. Tighten the screw down into the tube enough to flare the end as shown in here - Caution do not over tighten or you will crack the tubing and the fitting will leak.



7. Remove the tube from the flaring tool, assemble the fitting and tighten using the proper wrenches.

8. Hold your finger over one end of the tube, fill it with water and test for leaks.

9. Repeat steps 1-7 until the fitting holds water without leaking.

10. Take the connection to the instructor and have it approved.

Signed __________________________

FOR THE STUDENT

No. H 3-2

SERVICE

THE PLUMBER

MAKING A CAST-IRON PIPE JOINT

Objective:

Given the proper materials and tools you will cut to size and make a cast-iron pipe joint.

Activity:

Prerequisite skills should include the following plumbing skills: service sheets H 30 and H 31; and the ability to use a blowtorch for melting lead for use in making a sealing joint. Also refer to Service activity No. H 11, Hardware Store Sales of Plumbing Material for making a cast-iron pipe joint.

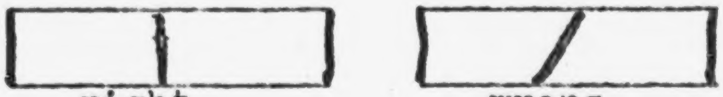
Pertinent information: Making a cast-iron pipe joint requires a procedure altogether different from any other type, as the pipe and the fittings are different. The pipe, usually sold in 5' lengths, has a larger diameter "hub" at one end, and a slight ridge around the other end, called a "spigot." It is also available with the hub at both ends. The hub and spigot diameters are such that the spigot fits inside the hub of an adjoining section with space to spare. This extra space is the basis for the joining system.

Whether you are joining one length of cast-iron pipe to another or to a fitting, the method is the same. In vertical runs of pipe, like a soil stack, the pipe is always erected with the hub ends up, so the lower end of each section of pipe fits inside the hub of the one below it.

1. Get required tools and supplies from your supply room. These tools and materials should include:

    1. Length of cast-iron soil pipe(to be cut)
    2. Hack saw
    3. Heavy hammer(3 to 5 lb.)
    4. Cold chisel
    5. Chalk or crayon
    6. 2 X 4 section approx. 2 ft. long
    7. Blowtorch
    8. Lead for melting in joint
    9. Oakum packing
    10. Pouring ladle(iron)
    11. Melting pot
    12. Yarning iron
    13. Caulking irons
    14. Pair of heavy work gloves

2. Mark off the amount of pipe you want to cut, depending upon the length of pipe needed. To cut the cast-iron pipe start by making 1/16"-deep cut with hacksaw all the way around. Be sure the cut is square with pipe. Chalk or crayon line around pipe is a good guide.



right wrong

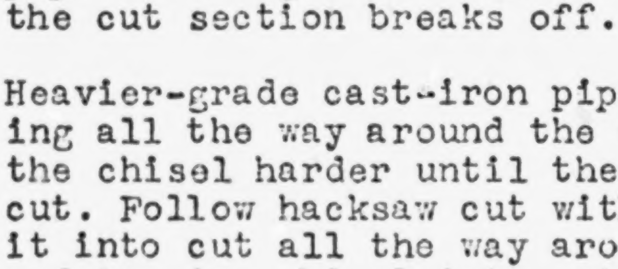
3. If pipe is the standard weight(3/16-1/4"-thickness-and 3½" in diameter) you can break off the end beyond the hacksaw cut simply by following up with hammer taps all the way around until the end clicks off.

4. Rest one section of the pipe on a piece of 2-by-4 with the saw cut just overhanging. Next, tap the pipe overhang with a hammer close to the cut until the cut section breaks off.

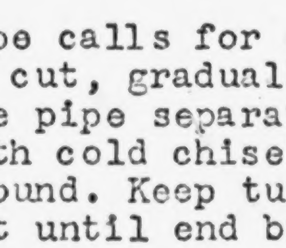
5. Heavier-grade cast-iron pipe calls for cold-chiseling all the way around the cut, gradually hitting the chisel harder until the pipe separates at the cut. Follow hacksaw cut with cold chisel, tapping it into cut all the way around. Keep turning pipe and tapping chisel into cut until end breaks off.

6. By planning carefully, it's usually possible to minimize the number of cuts required. And, if you're afraid of shattering the pipe, it's not too difficult to saw the standard weight all the way through. A blade with fourteen teeth per inch does the job fastest.

7. Now fit your two sections together, the spigot end into the hub end. When the two sections are fitted together make sure the upper one is centered in the hub of the lower one. You can use a brace to hold them upright and together or you can have them held upright and in place by clamping the top pipe in a table-mounted vise.

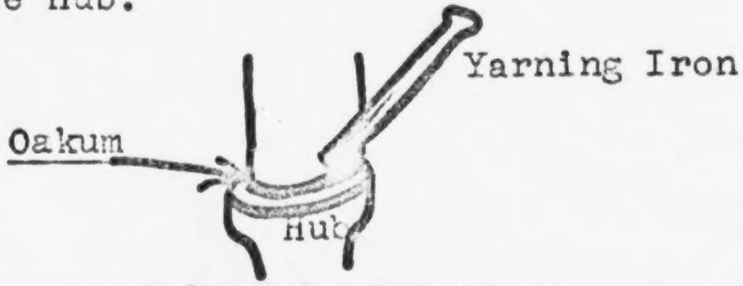


Brace can be mounted on table or vise



Vise used with board clamp to hold sections upright

8. The usual tool for the packing job is a "yarning iron" made for the purpose, or you can use a blunt-ended piece of narrow strap iron about a foot long. Simply wrap the oakum loosely around the inner pipe and bang it down firmly with the tool, using moderate hammer taps to pack it. Usually, you pack the oakum to within 3/4" or 1" of the top of the hub.

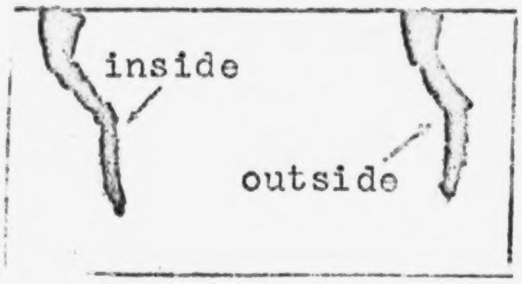


9. The next step is to pour molten lead into the hub on top of the oakum. Melt the lead in an iron pot. Support the pot on a rack and set a regular blowtorch to play its flame against the bottom of the pot.

Safety Note: It's important to heat the ladle in the torch flame briefly before filling it, as even a slight trace of moisture in it can cause the lead to spatter dangerously. You need heavy work gloves to protect your hands when the ladle handle heats up.

10. When the lead is melted, make sure your ladle is also heated, and dip into pot, first removing any scum at the top of the pot, and then pour molten lead into hub on top of packed oakum.

11. As soon as the lead is hardened it is "caulked" with a pair of caulking irons. These resemble offset chisels. The "inside" iron is shaped to make it easy to pack the lead against the pipe. The "outside" iron is designed to pack it against the inside of the hub. You do the packing by simply driving the sharp edge of the tool into the lead to spread it. You'll probably have to work the tools around the joint several times to tighten the joint completely.



12. When the job is completed to your satisfaction, take it to the teacher for final inspection.

FOR THE STUDENT No. H-33

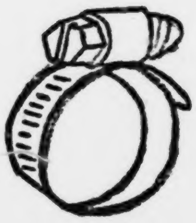
SERVICE

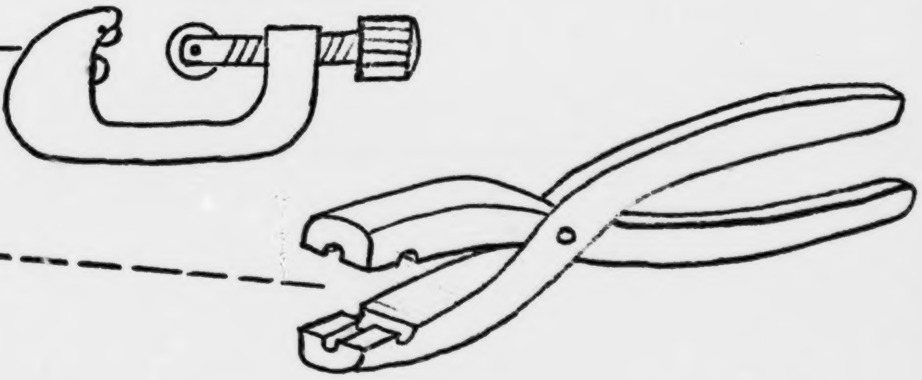
REPAIR OR REPLACEMENT OF METAL TUBING WITH FLEXIBLE HOSE AND CLAMPS

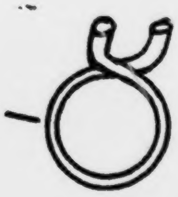
Objective:

You will be able to replace and/or repair metal tubing with a flexible neopreme hose, when given the following tools and materials.

1. A collared screw type hose clamp
2. A 2" piece of neopreme hose
3. A tubing cutter
4. A screwdriver
5. A hose clamp pliers
6. A 6" piece of 5/16" copper tubing
7. A spring type hose clamp







Prerequisite skills:

Package No. H-32 must be completed before starting this package.

Activity:

Follow the directions below to make the tubing connection.

1. Get the tools and materials listed above and take them to your work station.

2. Cut the 6" copper tube into two 3" pieces, using a tubing cutter.

3. Slide the spring type hose clamp onto the copper tube and push the neoprene hose onto the copper tube.

4. Using the hose clamp pliers, compress the clamp and slide it over the hose locating it about 1/4" from the end of the hose.

5. Hold your finger over one end of the tube, fill it with water and test for leaks.

6. Repeat above procedure until the connection holds water without leaking.

7. Now slide the screw type hose clamp onto the copper tube, then push the hose onto the copper tube.

8. Locate the clamp about 1/4" from the end of the hose and tighten the clamp with a screwdriver.

9. Check with water for leaks, as done with the first connection.

10. Take the connections to the instructor and have them approved.

Signed ____________________________

FOR THE STUDENT NO.. H-34

SERVICE

INSPECTING AND BLEEDING HYDRAULIC BRAKES

Objective:

Given an automobile, you will be able to inspect and bleed the hydraulic brake system when provided the following materials and equipment.

1. Pressure bleeder assembly
2. Hoist
3. Bleeder wrenches
4. Penetrating oil
5. Brake fluid
6. Tire pump or shop air supply
7. Small glass jar and 12" of 1/4" neoprene hose
8. Slide projector - tape recorder and slide show titled, "How to Inspect and Bleed Brakes"

Activity:

A. Locate set-up and look at slide show called "How to Inspect and Bleed Brakes".(Get handout sheet from your instructor)

B. After watching the slide show have your instructor assign you to a car, then follow the check list below to inspect and bleed the brake system.

   1. Get the materials and equipment listed above and take them to your work station
   2. Pressurize the bleeder assembly
   3. Locate proper adaptor for master cylinder and hook up pressure bleeder assembly
   4. Raise car on hoist to inspect system
   5. Check lines

6. Check flexible hoses and connections

7. Check backing plates for signs of fluid leaking

8a. If you find a problem, report it to the instructor

b. If the system is "ok", go on to step #9

9. Spray each bleeder screw with penetrating oil

10. Break loose bleeder screws carefully and do not break them off. Check with your instructor if you have a problem.

11. Attach hose to bleeder screw and place the other end in the jar of brake fluid

12. Open each bleeder screw to remove the air from the system - REMEMBER - start at the wheel furthest from the master cylinder and work your way toward the master cylinder

13. Check the brake pedal to test your work. Repeat step #12 if the pedal feels spongy and go on to #14 when the pedal feels hard.

14. Have your instructor check your work and sign below

Signed ______________________________

HANDOUT SHEET

NO. H-34

FOR SLIDE SHOW
"HOW TO INSPECT AND BLEED BRAKES"

Let's review - Part I

1. ______________________________

2. ______________________________

____

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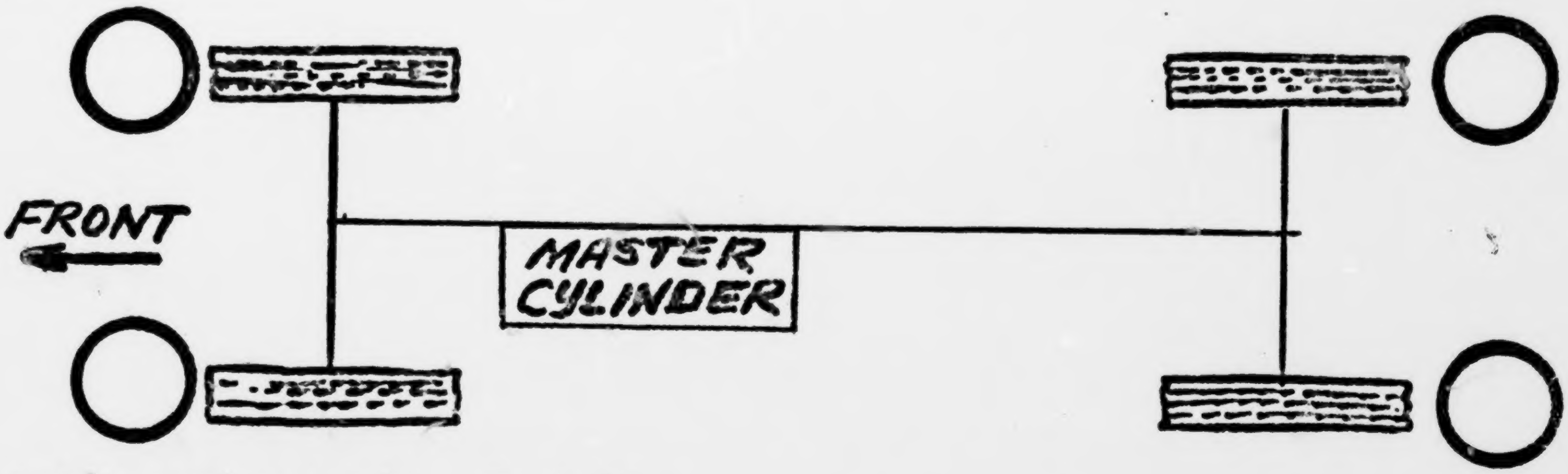
3. ____

4. ____

5.


FRONT
MASTER CYLINDER

Let's review again - Part II

1. ______________________________ ______________________________

2. ____

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TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-34

Slide Show on "How to Inspect and Bleed Brakes"

Slide #	Visual	Narration
0.	Focus slide	
1.	Start tape recorder	Follow the directions on this tape to advance the slides as you watch the presentation. When you are given a slide #, move to the slide showing that number on the screen. Most of the numbers will be in the upper left hand corner of the screen. Turn to slide 2.
2.	Picture of girl standing along road	Turn to slide 3.
3.	Skid marks	(Screech of tires sound effect). Slide 4.
4.	Skid marks and vehicle stopping	(Tire noise sound effect). Too bad you couldn't stop in time to pick her up. Good brakes can be very important. Slide 5.
5.	Picture of foot on a spongy pedal	If a car's hydraulic brake system has air mixed in with the brake fluid, the pedal will feel spongy. This spongy feeling is caused by the air compressing as pressure is applied to the brake pedal. This condition causes poor braking. Slide 6.
6.	Main title slide: How to Inspect and Bleed Brakes	This slide presentation will show you how to remove the air and inspect the brake system. Slide 7.
7.	Produced by Joe Jandasek	Turn to slide 8.
8.	Sub title: How Brakes are Bled	You will see how brakes are bled. Turn to slide 9.
9.	Sub title: How to Identify and Use Brake Bleeding Equipment	You will learn how to identify and use brake bleeding equipment. Slide 10.
10.	Sub title: How to Identify Hydraulic Brake System Problems	You will see how to identify some common hydraulic brake system problems. Slide 11.
11.	Bleeding Brakes (Heading)	Let's look at the brake bleeding procedures. Slide 12.

Slide #	Visual	Narration
12.	Sub heading: 2 methods 1. Pressure bleeder 2. Manual	There are two methods of bleeding brakes. One is the pressure bleeder method. The second is the manual bleeding method. Slide 13.
13.	Pressure bleeder tank hooked up to the master cylinder	First, let's look at the pressure bleeder method. The picture you see here is the pressure bleeder assembly hooked up to a master cylinder. Turn to slide 14.
14.	Pressure bleeder tank with 1/3 marked on it	To bleed brakes with the pressure bleeder you will first have to fill the tank about 1/3 full with approved brake fluid. Slide 15.
15.	Bleeder tank showing air valve and fluid valve	Now, put 20 pounds of air into the bleeder tank through the valve shown by the arrow in this slide. A standard air chuck used to inflate a tire will fit this valve. This air pressure will force the fluid out of valve (A), shown in this picture, and supply fluid under pressure when valve (A) is opened. Slide 16.
16.	Picture of adaptor for master cylinder hook up	Next, you must hook up the pressure bleeder to the master cylinder. This slide shows several adaptors used to connect the bleeder tank hose to the master cylinder. Turn to slide 17.
17.	Picture of bleeder tank hooked to master cylinder	Select the correct adaptor and fasten it to the master cylinder. Then hook up the hose from the tank to the adaptor as you see in this picture. Slide 18.
18.	Pressure bleeder hooked to master cylinder in the car	Open the valve labeled (A). This will allow fluid to flow into the master cylinder and puts the entire car's brake system under pressure. This also keeps the brake system supplied with brake fluid during the bleeding process. Slide 19.
19.	Car being raised on hoist	With the pressure bleeder hooked up, the car must be raised so that we can inspect and bleed the brake system. Slide 20.
20.	Man looking under car on hoist	Before you bleed the system, look for signs of brake fluid leaking. Remember, the system is under pressure and leaks should be easier to see. Turn to slide 21.

Slide #	Visual	Narration
21.	Man running hand along brake lines	Look for wet spots along the brake lines and fittings. You should learn to recognize the smell of brake fluid because many times a leak can be smelled more easily than it can be seen. Slide 22.
22.	Man pointing to brake hose	Check flexible hoses at ecah wheel. Slide 23.
23.	Hose in bad shape	Look carefully for cracks in the hose that might cause a brake failure in the near future. Slide 24.
24.	Backing plate with wet spot and man pointing to it	Look for wet spots on the backing plates at each wheel. This might indicate that a wheel cylinder is leaking. Immediate rebuilding will be necessary if any wheel is found to be leaking. Turn to slide 25.
25.	Picture of wrecked car	Remember, you the mechanic, are the only person that has the chance to find the problems before they cause a wreck like this. Always inspect the system carefully - someone's life may depend on you! Turn to slide 26.
26.	Several types of brake bleeder wrenches	If the system is ok, you should now select a bleeder wrench to fit the bleeder screw on the car you are about to service. Shown here are some common types of brake bleeder wrenches. Slide 27.
27.	Wrench being placed on bleeder screw	Now that you have the proper wrench, break loose each bleeder screw as shown in this slide. Just break it loose, and leave it snugly closed so that fluid does not leak out. Slide 28.
28.	Penetrating oil being sprayed on to a bleeder screw	If the bleeder screw is hard to break loose, spray it with penetrating oil and wait a few minutes, then try again. If this doesn't help, get the instructor. Slide 29.
29.	Broken bleeder screw	Don't force the bleeder screw - they break very easily. Slide 30.
30.	Cartoon of wrench being forced with a hammer	Remember to use that penetrating oil, please don't be a Primitive Pete! Slide 31.

Slide #	Visual	Narration
31.	Picture of hose hooked from bleeder screw to jar of fluid (1/2 full)	Now let's get the air out of that brake system. Hook one end of a rubber hose to the bleeder screw and place the other end into a jar half full of brake fluid. Slide 32.
32.	Picture of hose in a jar of fluid showing bubbles in fluid	Using this jar of fluid you will be able to tell when all of the air is out of the system. As long as you see bubbles in the jar, as seen in this slide, you know air is still coming out of the system through the hose. Slide 33.
33.	Picture of hose in jar of fluid with no bubbles in fluid	When the bubbles no longer appear, as seen in this picture, you know that only fluid is coming out of the hose. This means that the air has been bled from that part of the brake system. Turn to slide 34.
34.	Diagram of 4 wheels showing order in which wheel cylinders are to be bled	Now open the bleeder screws, one at a time, starting with the wheel cylinder farthest from the master cylinder and work your way toward the master cylinder, as shown in the diagram. Move to slide 35.
35.	180° turn shown by diagram	The bleeder screws should be open about 1/2 turn, as shown, for 1 or 2 seconds at a time. This opening and closing action removes more air faster and less fluid is wasted. Turn to slide 36.
36.	Picture of jar of fluid and hose hooked from bleeder screw to jar	When bubbles no longer appear in the jar, move to the next wheel cylinder. Repeat this procedure until all (4) wheel cylinders are bled. Move to slide 37.
37.	Picture of foot on brake pedal with sponge under the foot	Now check your work by pushing on the brake pedal. If the pedal feels firm, you are done. If it feels spongy, you must repeat the bleeding procedure until satisfactory results are obtained. Slide 38.
38.	Heading slide: Review	Now let's review what you have learned. Place your answers in the spaces provided on the handout sheet you were given before the slide show began. Slide 39.
39.	Question written same as narration	1. How much air pressure should be placed in the pressure bleeder tank? (Place your answer in space #1) *PAUSE (time for writing answer). Turn to slide 40.

Slide #	Visual	Narration
40.	Question written same as narration	2. Where should you look for signs of hydraulic brake system failure? (Place your answer in space #2) *PAUSE (time for writing answer). Turn to slide 41.
41.	Question written same as narration	3. If the bleeder screw is difficult to remove, what should you do? (Place your answer in space #3) *PAUSE (time for writing answer). Turn to slide 42.
42.	Question written same as narration	4. How does the pedal feel if there is air in the system? (Place your answer in space #4) *PAUSE (time for writing answer). Turn to slide 43.
43.	Question written same as narration	5. Number the picture to show the order in which you should bleed the wheel cylinder. (Place your answer in space #5) *PAUSE (time for writing answer). Turn to slide 44.
44.	Answers to questions	Now check your own answers. #1. 20 lbs. of air pressure should be placed in the bleeder tank. #2. Look for signs of failure at the fittings, connections, backing plates and brake lines. Turn to slide 45.
45.	Answers to questions	Answer to question #3. Penetrating oil should be used to loosen difficult bleeder screws. #4. The pedal would feel spongy if air is in the system. Turn to slide 46.
46.	Diagram of 4 wheels numbered to show order of bleeding procedure	Check your answer for #5 against the diagram in this slide. Slide 47.
47.	Sub title: Manual Method	Next, let's take a look at the manual method of bleeding brakes. This procedure is almost the same as the pressure tank method, except the way by which we pressurize the fluid in the system. Turn to slide 48.
48.	Picture of 2 animated characters	Two men are needed for the manual method o bleeding brakes. One man is needed to pum the brake pedal in order to put the system under pressure. The second man works under the car, opening and closing the bleeder screws to get rid of the air in the system. Slide 49.

Slide #	Visual	Narration
49.	Question - Same as narration	What happens if the master cylinder runs out of fluid during the bleeding procedure? If you don't know the answer now, look for it in the slides to follow. Slide 50.
50.	Picture showing master cylinder being filled	First, you must fill the master cylinder because you do not have a constant supply of fluid as you did when using the pressure bleeder. Slide 51.
51.	Foot shown pumping brake pedal	Now, one man pumps the pedal several times until it is as high off the floor boards as possible. Keep foot pressure on the pedal. This pressurizes the brake system. Slide 52.
52.	Wrench on bleeder screw and hose in jar	With the brake system under pressure, the second man opens and closes the bleeder screw. The pedal will sink to the floor boards as the brake fluid and air escape into the jar. Slide 53.
53.	2 animated men shouting at each other	It is important for both men to give direction to each other at this point because the bleeder screw must be in the closed position before the pressure on the pedal is released. If the pedal is released with the bleeder screw open, fluid and air from the jar will be sucked back into the system. Slide 54.
54.	Foot pump pedal-repeat of slide 51	Now, with the bleeder screw closed, pump up the pedal again and repeat the bleeding procedure until bubbles no longer appear in the jar. Then repeat the bleeding procedure fo each wheel cylinder, just as done with the pressure bleeder method - BUT - PAUSE - turn to slide 55. - PAUSE
55.	Picture of master cylinder being refilled - same as slide 50	Remember to refill the master cylinder afte each wheel cylinder so that the master cylinder never runs dry during the bleeding operation. If the master cylinder did run dry, you would pump air into the system instead of fluid and you would have to start all over again. Turn to slide 56.

Slide #	Visual	Narration
56.	Foot on sponge on pedal	Now check your work by pushing on the brake pedal. If it feels spongy, you must repeat the bleeding procedure until the pedal feels firm. When the pedal feels firm the bleeding job is complete. Now turn to slide 57 - AND -
57.	Sub heading: Let's review again	let's review again. Answer the questions by placing your answers on the sheet you have been provided. Turn to slide 58.
58.	Question - basically same as narration	#1. Name the 2 methods of bleeding brakes. Put your answer in space #1 at the bottom of the page. Turn to slide 59.
59.	Question - basically same as narration	#2. What happens if the master cylinder runs out of fluid during the manual bleeding procedure? Now turn to slide 60 and check your answers.
60.	Answers to questions Content basically same as narration	#1. Manual bleeding method and pressure bleeding method. #2. If the master cylinder runs out of fluid during the manual bleeding procedure, air would be pumped into the system through the master cylinder. Slide 61.
61.	Girl along the road - car stopping quickly	Short squeal of tires. Slide 62.
62.	Back end of car with THE END written on it	

FOR THE STUDENT

SERVICE

IDENTIFICATION OF LUBRICANTS

Objective:

Provided with jars containing 7 different lubricants, you will be able to name and state at least one use for each lubricant.

Activity:

1. Locate the 7 labeled jars containing lubricants.
2. Read the label, then remove the jar top and examine the contents by smell, touch, color and thickness.
3. Replace the top on the jar and look at the chart below to see where this lubricant is used.

Type of Lubricant	Uses
1. Motor oil	General purpose lubrication, engine lubricating systems, drive chains, and hinges
2. Graphite oil	Door locks, penetrates rusted parts and stands up under high temperatures
3. Penetrating oil	Penetrates and frees up rusted or frozen parts
4. General purpose grease (lithium type)	Auto chassis lubrication, universal joints, and protection of exposed parts
5. Wheel bearing grease	A fiberous grease for high speed bearings (does not run at high temperatures)
6. Gear lube (90wt. grease)	Auto differentials, standard transmissions, outboard motor lower unit gears
7. Type "A" hydraulic oil (automatic transmission fluid)	Automatic transmissions, power steering units, hydraulic systems used in assembly line automatic equipment

4. Now turn to page 2 and see if you can identify the lubricants.

5. Get the 7 jars without labels from your instructor. These jars are numbered 1 through 7.

6. Open jar number 1 and write the name of the lubricant after number 1 on the blank chart below. (Do not turn back to page 1).

7. Follow the same procedure for the remaining jars, then replace all the jar tops tightly.

Name or Type of Lubricant	Use of Lubricant
1.	
2.	
3.	
4.	
5.	
6.	
7.	

8. Fill in the proper use of each of the 7 lubricants in the space provided in the chart above.

9. Now check your own work against the chart on page 1.

10. If you have them all correct, place your name at the bottom of this sheet and turn your paper into the instructor. Repeat steps 2 and 3 for any lubricants you did not know and try the test again.

Signed ______________________________

FOR THE STUDENT NO. H-36

SERVICE

IDENTIFICATION OF OIL BY SERVICE RATING AND VISCOSITY

Objective:

Given several cans of motor oil, you will be able to identify the oil by service rating and viscosity and explain what each means.

Activity:

1. Get 3 cans of oil from your instructor.
2. Look for the letters MS, MM, ML, DS and/or DG printed somewhere on the oil cans. These markings are called service ratings. The service rating tells you the type of service for which this oil is designed.
3. Now, look at the chart below and you will see when each of these oils should be used.

Oils designed for use in spark ignition engines

MS	designed for	severe service and unfavorable operating conditions
MM	designed for	medium service
ML	designed for	light service

Oils designed for use in diesel engines

DS	designed for	severe service-heavy load conditions
DG	designed for	light to normal service conditions

4. Look for the SAE (Society of Automotive Engineers) numbers generally located on the top of the can. For example, SAE10, SAE20, SAE30 and SAE10W tell you the viscosity rating of the oil. The SAE10 weight oil is lighter and flows more like water, while the SAE30 weight oil is heavier and would flow more like honey. There are three special ratings for winter grade oils; SAE5W, SAE10W, and SAE20W - the "W" standing for winter grade.

5. The examples in the chart below will show you when these different viscosity oils should be used.

Viscosity Ratings	Recommended Use
SAE5W	Winter - but not recommended for summer or high temperatures
SAE20W	Winter - but not recommended for summer or high temperatures
SAE10	Moderate temperatures and not for winter conditions
SAE30	All except winter and good at high temperatures
SAE10W-30	All weather summer or winter

6. Get the 3 cans of motor oil from your instructor labeled 1, 2, and 3.

7. Now fold this paper on the dotted line above.

8. Fill in the viscosity rating and service ratings from each of the oil cans (1, 2 and 3).

Can Number	SAE Viscosity Rating	Service Rating	Recommended Uses	
			Temperature or Weather Conditions	Type of Engine & Service Conditi
1				
2				
3				

Sign your name here ____________________

9. Try to complete the recommended uses in the chart above for all 3 cans of oil without looking back.

10. Now, check your answers by looking back at steps 2 to 5. If you got all the answers right, turn in this sheet. If you made any mistakes look up the correct answers and make the corrections on the chart before turning in your paper.

FOR THE STUDENT NO. H-37

SERVICE

LUBRICATING MACHINES AND EQUIPMENT

Objective:

Provided a machine needing lubrication, several lubricants and lubrication equipment, you will be able to select the right lubricant and properly lubricate the machine.

Prerequisite Skills:

You should do package NO. H-35 before trying to do this package.

Activity:

1. Look at the pictures in the chart below. Then, look around your shop and list as many machines as you can that use each method of lubrication.

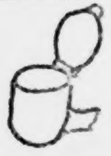
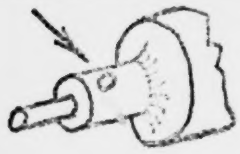
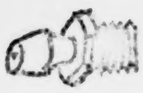
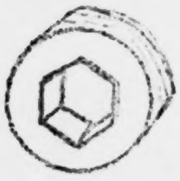
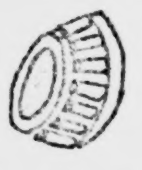
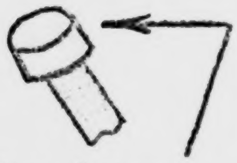
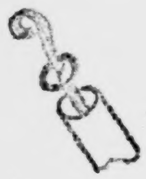
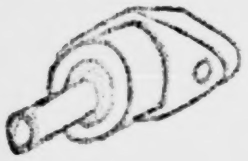
Picture	How to Lubricate	Type of Lubricant You Should Use	Examples
 Oil Cup	Lift cap to open position as seen here, and fill cup - then close	Use Motor Oil (Check service manual for recommended weight)	
 Access Hole	Apply 2 or 3 drops of oil	Use Common Motor Oil (Check service manual for recommended weight)	
 Zerk	Use a grease gun to force grease into the "zerk". Just fill joint-don't over lub.	General Purpose Grease-(see manual for special recommendations)	
 Fill Plug	Remove the plug and fill to lower edge of hole or with the recommended quantity	Gear Lube (90 wt. grease)	

Chart continued on next page -

Picture	How to Lubricate	Type of Lubricant You Should Use	Examples
 High Speed Bearing	Pack with grease - force grease into bearing thoroughly	Wheel Bearing Grease	
 Crankcase Breather Cap	Remove oil breather cap - fill to proper level as measured by "dip" stick and replace cap	Common Motor Oil (Check service manual for recommended wt.)	
 "Dip" Stick Opening	In some cases oil reservoirs must be filled through the "dip" stick opening (Careful - do not overfill)	Automatic Transmission Fluid (Check manufacturer's recommendations)	
 Factory Sealed Units (No place for lubricant to be added	Some equipment is now built with the lubricant sealed in at the factory. No way is provided to lubricate these parts after they leave the manufacturer.	Factory Lubricated	

2. Now, look back at the chart and see how to lubricate each of the machines you listed.

3. Next, look at the chart to see what type of lubricant you should use for each machine listed.

Post Test:

1. See your instructor and have him assign you to a machine needing lubrication.

2. Write the name of the machine here ______________________.

3. List the parts to be lubricated and then list the type of lubricant you plan to use.

	Parts to be Lubricated	Type of Lubricant
A		
B		
C		
D		
E		

4. STOP! See the instructor or shop forman and have him check the list above before you go on to #5.

5. Get the lubrication equipment and the lubricants you listed.

6. Now, lubricate the machine and get your instructor's approval when completed.

   Instructor's Approval ______________________________

7. Sign your name and turn in your paper after approved by the instructor.

Student's Name ______________________________

FOR THE STUDENT NO. H-38

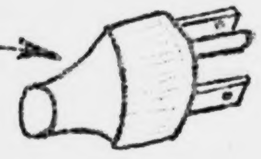
SERVICE

ELECTRICAL REPAIR
(WIRING AN ATTACHMENT PLUG)

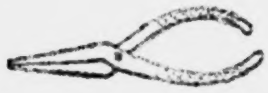
Objective:

You will be able to properly wire an attachment plug, given the following tools and materials.

1. Attachment plug (with ground)



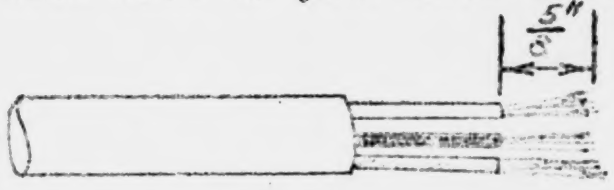
2. 16-3 rubber covered cord
3. Needle nose pliers



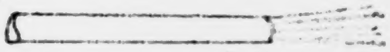
4. A knife (or wire stripper, if available)
5. Screwdriver
6. Sample of properly wired attachment plug

Activity:

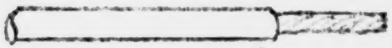
1. Get the tools and materials and take them to your work station
2. Remove the insulation from the wires as shown here (Be careful not to cut into the wire)



3. Twist the strands of wire together in a clockwise direction as shown here

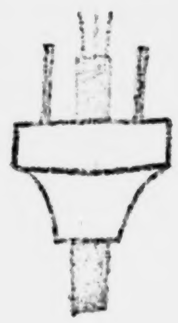


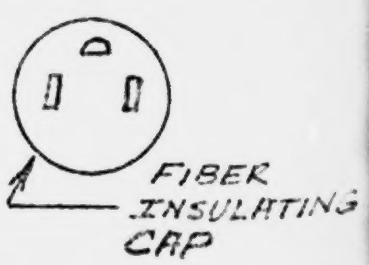
(BEFORE TWISTED)



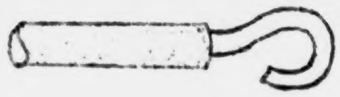
(TWISTED TOGETHER)

4. Remove the fiber insulating cap and feed the wire through the plug as shown

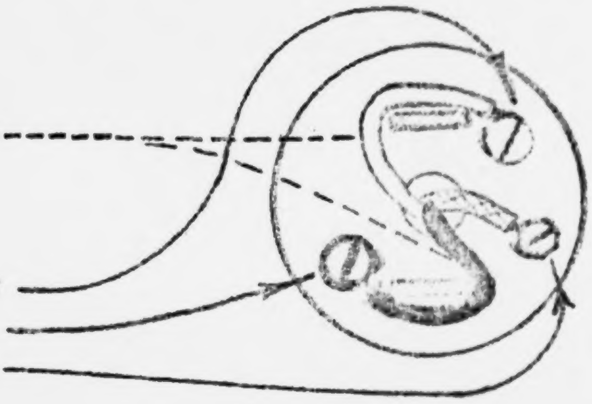




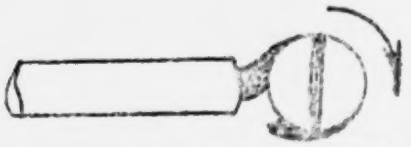
5. Using the needle nose pliers, make a loop at the end of each wire as shown



6. Place the wires around the prongs as shown here ----------------
The screws for electrical connections are color coded -
white wire goes to silver screw
black wire goes to brass screw
green wire goes to green screw



7. The wire loop should always be wound around the screws in a clockwise direction as shown here ---------------------



8. Hook up all 3 wires and tighten with a screwdriver, then tighten the clamp on the base of the plug (if there is one)

9. Now have your instructor sign below approving the wiring; then replace the fiber insulating cap to complete the job

Instructor approval ______________________________

FOR THE STUDENT NO. H-39

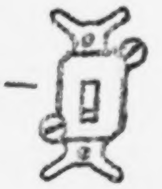
SERVICE

ELECTRICAL REPAIR
(REPLACING A SINGLE POLE LIGHT SWITCH)

Objective:

You will be able to replace a single pole light switch, given the following tools and materials.

1. A single pole light switch—————————

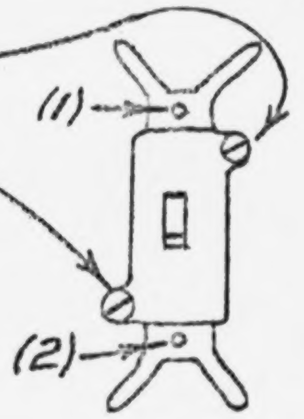


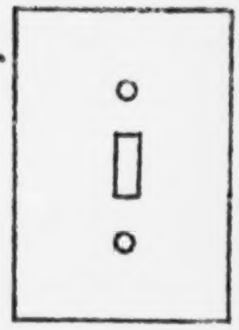
2. A screwdriver
3. A needle nose pliers ———

4. A working single pole light switch complete with electrical supply, box and wall cover plate

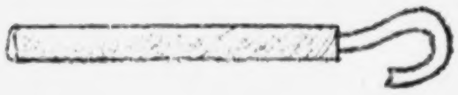
Activity:

1. Get the tools and materials listed above and take them to the work station
2. TURN OFF THE ELECTRICAL POWER so you don't get a SHOCK!!!
3. Remove the wall cover plate with a screwdriver. Careful so you do not slip and scratch the wall plate
4. Loosen screws and remove the electrical wires (do not bend any more than necessary)
5. Remove screws labeled (1) and (2) and remove light switch from the electrical box

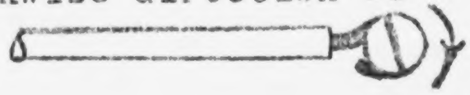




6. Using the needle nose pliers, check and shape the loops at the end of the wires to look like this ————————————————

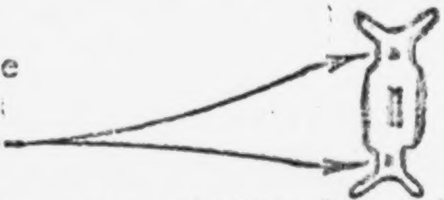


7. Place one wire under the head of each screw and tighten them with a screwdriver. The wire loop should always be wound around the screw in a clockwise direction as shown here ----------------



The color of the wires do not matter on a single pole switch hook up.

8. Now fasten the switch to the electrical box with the two screws as shown here ------



9. Get your instructor to check your wiring-have him sign below if approved.

Instructor approval ______________________________

10. Replace the wall cover plate, turn on the electrical power and make sure the switch works.

FOR THE STUDENT NO. H-40

SERVICE

READING ELECTRICAL SCHEMATIC DIAGRAMS

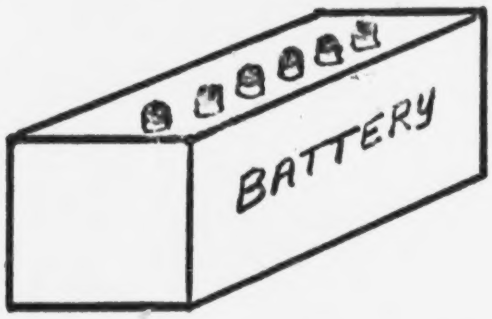
Objective:

You will be able to read an electrical schematic diagram containing any of the following symbols; battery, conductor or wire, ground, crossing wires connected and unconnected, switch, fuse and resistor. ("Read" means to name the parts when shown the symbol).

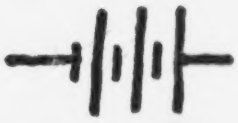
Activity:

Read the information and answer the questions, then check your answer by folding up the answer tab.

1. A drawing showing an electrical circuit is called an electrical schematic diagram.
2. Schematic diagrams use symbols as a shorter way to show electrical parts in a circuit.
3. A picture of a battery might look like this



A symbol for this battery would look like this



4. If you had to draw 100 batteries, which way would be faster?

Picture
Symbol

Write your answer here ______________

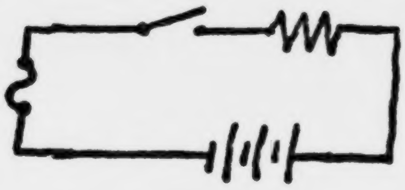
Now check your answer by folding up tab #1.

Tab #1

SYMBOL

5. All electrical components have symbols that are easy to draw and use in schematic diagrams.

This is a simple
Schematic Diagram



6. Draw the symbol for a battery

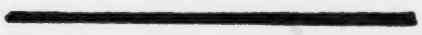
Answer ______________________

Tab #2

Fold over tab #2 and check your answer.

7. Electrical circuits have wires or conductors to carry the electricity.

The symbol for a wire or conductor
looks like this



8. Draw a wire connected to a battery.

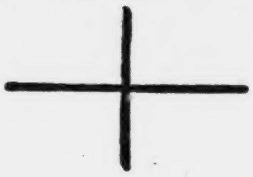
Answer ______________________

Tab #3

Now check your answer by folding up tab #3.

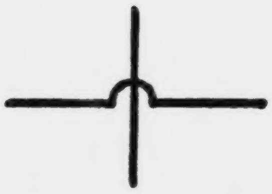
9. When wires cross in a schematic diagram they can

connect like this

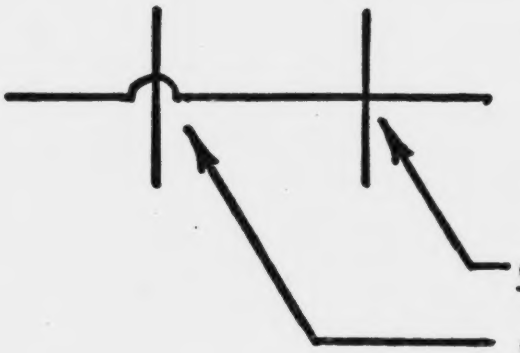


or

cross without connecting like this



Circle the right answer on each line below

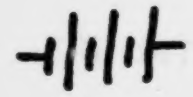


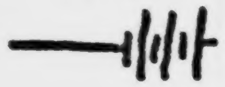
connected unconnected

connected unconnected

Tab #4

Now turn over tab #4 and check your answers.



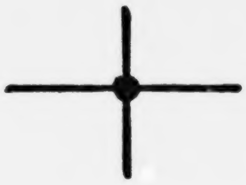


CONNECTED

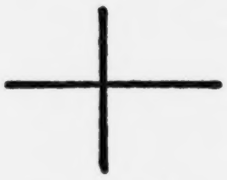
UNCONNECTED

10. Sometimes another method of showing connected or unconnected wires is used.

When the lines cross with
a dot like this
they are connected



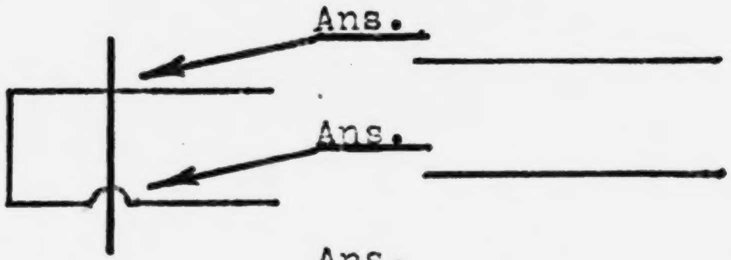
When the lines cross without
a dot like this
they are not connected



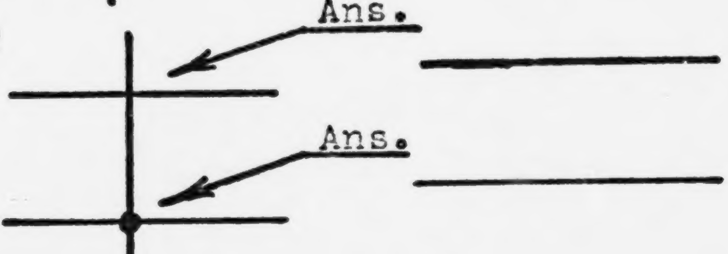
The two methods must not be used at one time - only one method can be used in any schematic drawing.

11. Write connected or not connected for each method on the symbols shown below.

Method 1



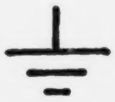
Method 2



Tab #5

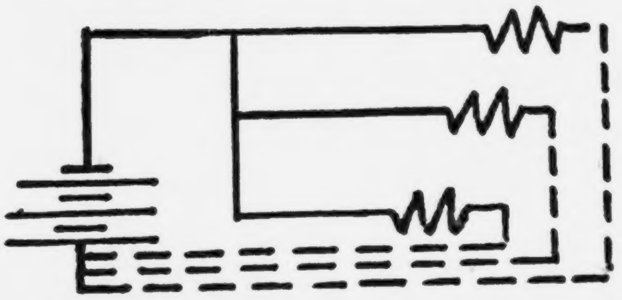
Check your answer by folding over tab #5

12. A ground symbol is used to show a path for electricity from the load back to the power source without drawing so many lines on the drawing.

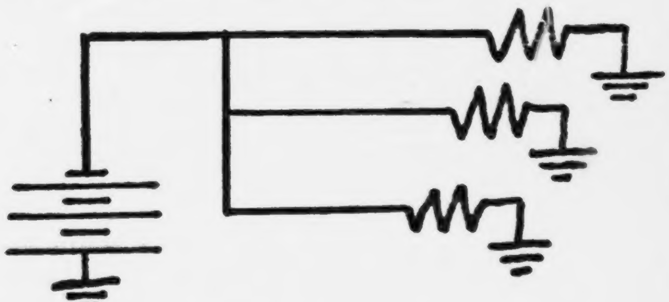


This is a Ground Symbol

Example:
This is a schematic
without ground symbols



This is a schematic
with ground symbols



Ground symbols make the schematic easier to draw and easier to read.

CONNECTED

NOT CONNECTED

NOT CONNECTED

CONNECTED

Draw a ground symbol.

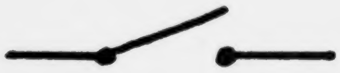
Tab #6

Answer ____________________________

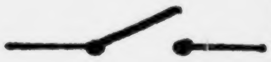
Turn up tab #6 and check your answer.

13. Switches are used in circuits to turn on or off the flow of electricity.

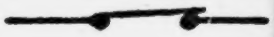
One symbol used for a simple switch looks like this →



A switch in the open position looks like this → and electricity cannot flow (circuit not complete)



A switch in the closed position looks like this → and electricity can flow (complete circuit)



Draw the symbol for a simple switch in the open position.

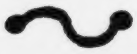
Tab #7

Answer ________________________

Turn up tab #7 and check your answer.

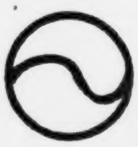
14. When too much (current) electricity flows through a circuit the wires or other electrical parts may get too hot and burn out so fuses are used to protect the circuit against damage.

The symbol for a fuse looks like this →



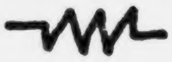
15. Electricity passes through a load to ground. A light bulb or lamp is a load.

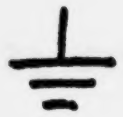
The symbol for a lamp looks like this →



A resistor is a load.

The symbol for a resistor looks like this →





16. Draw the symbols for each of the following electrical components.

Tab #8

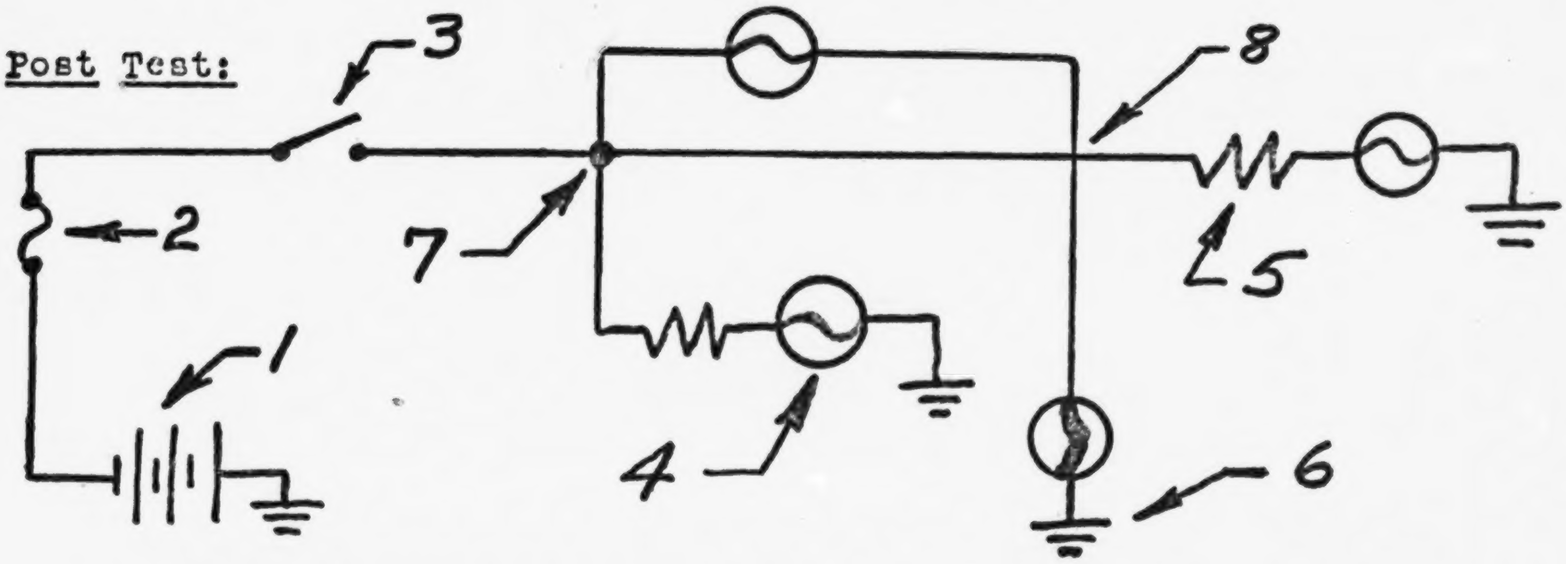
Fuse ____________

Lamp ____________

Resistor ____________

Turn up tab #8 and check your answer.

Post Test:



Read the schematic diagram above and name each component after the numbers listed below.

Symbol #1 ______________________

Symbol #2 ______________________

Symbol #3 ______________________

Symbol #4 ______________________

Symbol #5 ______________________

Symbol #6 ______________________

Circle the answer that best describes the schematic diagram.

Symbol #3 open closed

Symbol #7 connected not connected

Symbol #8 connected not connected

Turn up the tab and check your answer.

Tab

Battery
Fuse
Switch
Lamp
Resistor
Ground

Open
Connected
Not Connected

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-40

Pages 1 through 6 of this package must be cut to facilitate folding. Cut on the horizontal solid lines for each tab so that each tab may be folded up individually as the student checks his answers.

Prerequisite Skills:

The student should understand the purpose of the following components in an electrical circuit:

Fuse
Battery
Conductor
Resistor
Ground
Switch

TEACHER PACKAGE

SERVICE

READING PARTS BOOK

Objective:

The student will be able to locate part numbers when provided a parts book or chart and the name of the part.

Activity:

(Note to Teacher) Run a thermofax transparency of 3 pages of an available parts book or chart. Underline a part name and number on 2 pages before making the transparency. On the third transparency, write only the part name at the top of the page.

1. Students view and discuss, as a class, the 2 underlined transparencies.
2. Now each student writes the part name for the third transparency on a scrap piece of paper. Then he is asked to locate and record the numbers after the part name. After all students are finished, the answer is given and discussed if necessary.

Post Test:

Assign each student 3 parts and the parts book or chart and have them record the proper parts number after each part.

Student's name ______________________________

Part Name		Part Number
1. ____________	-	____________
2. ____________	-	____________
3. ____________	--	____________

FOR THE STUDENT NO. H-42

SERVICE

READING A MICROMETER

Objective:

Given several pictures of micrometers, you will be able to read the measurements shown.

Prerequisite Skills:

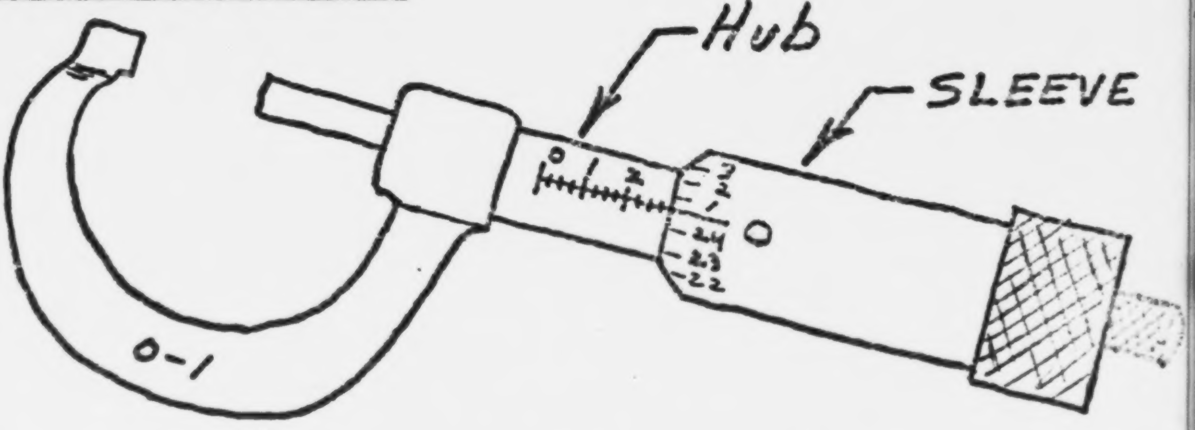
You must be able to read and write decimals.

Activity:

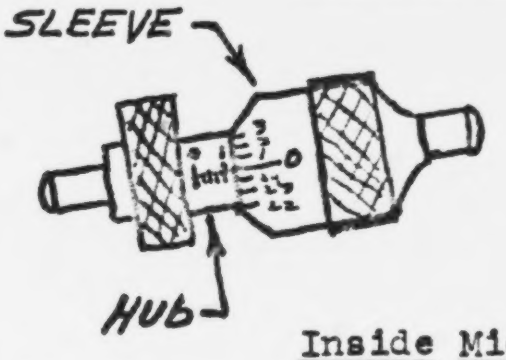
1. A micrometer is an instrument that measures objects to an accuracy of .001 of an inch and smaller in some cases.

These are Micrometers

You read a micrometer by reading the numbers on the HUB and the SLEEVE



Outside Micrometer



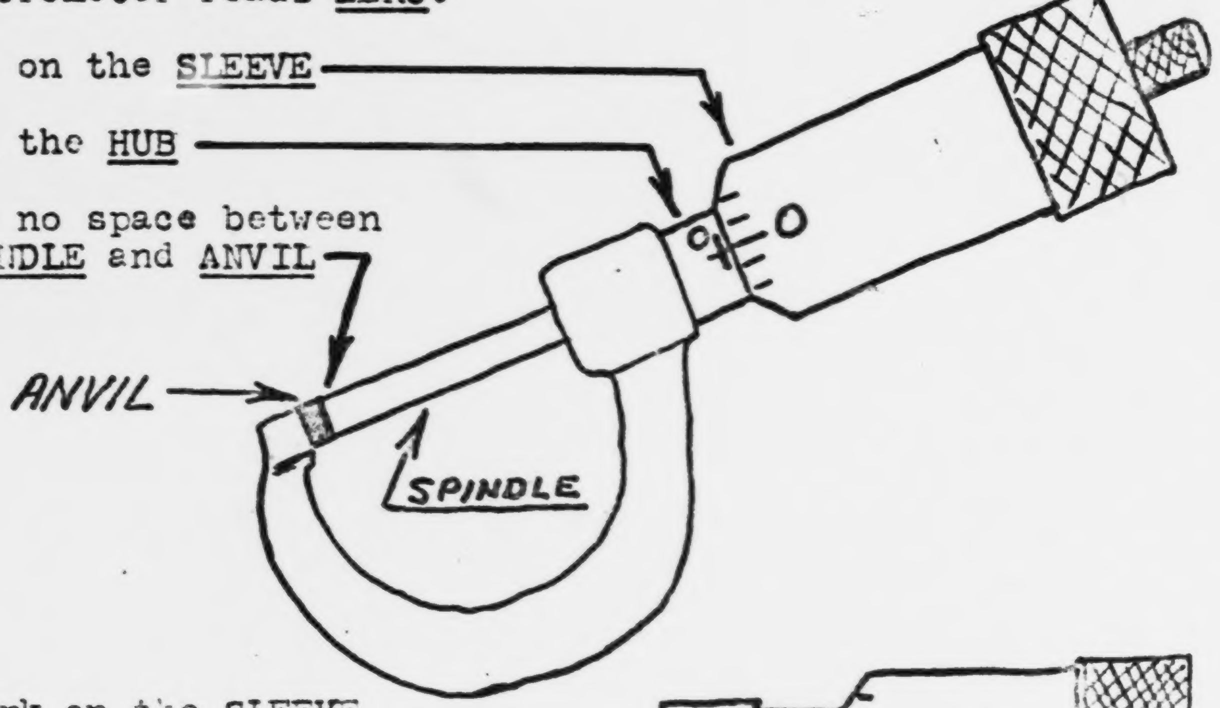
Inside Micrometer

2. This micrometer reads ZERO.

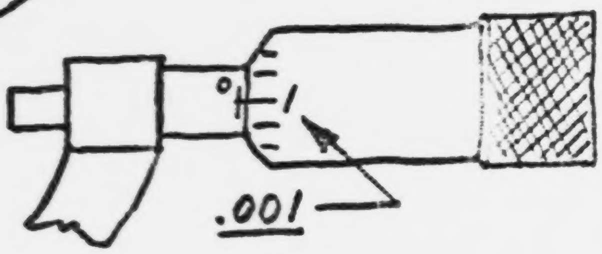
ZERO is on the SLEEVE

ZERO on the HUB

ZERO or no space between the SPINDLE and ANVIL



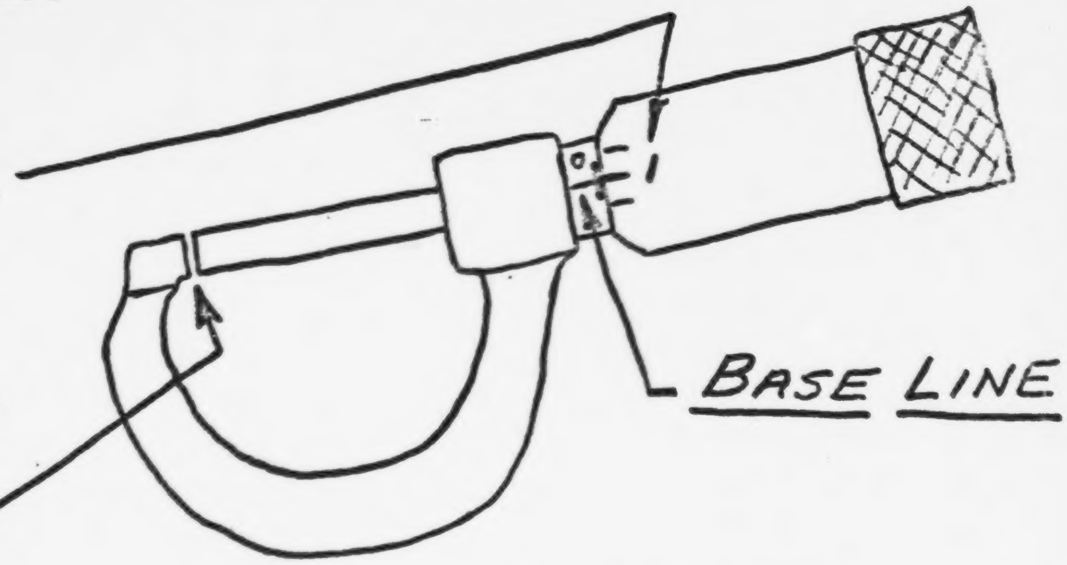
3. Each mark on the SLEEVE is .001 of an inch. This micrometer reads .001 of an inch.



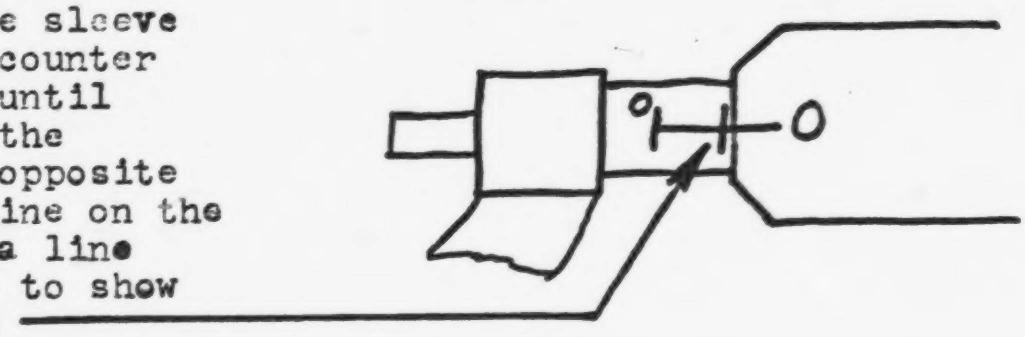
4. The sleeve on the micrometer turns. When the sleeve is turned counter clockwise the space between the anvil and spindle gets larger.

If the sleeve is turned counter clockwise so the "1" on the sleeve is lined up with the base line on the hub as shown here

The space between the spindle and anvil is exactly .001 of an inch



5. Now, if the sleeve is turned counter clockwise until "zero" on the sleeve is opposite the base line on the hub again a line will begin to show on the hub



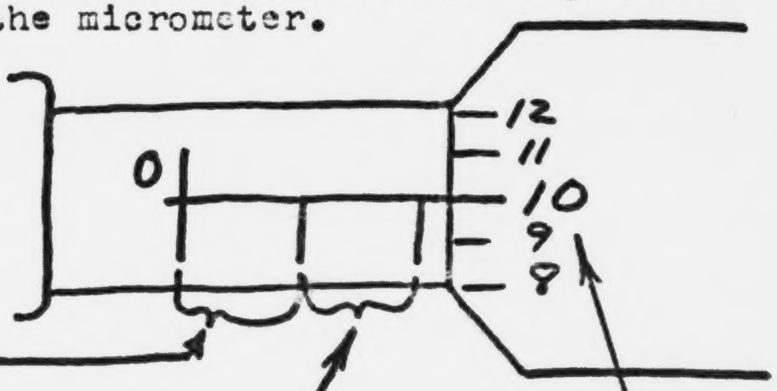
This line reads .025 of an inch and the space between the spindle and anvil is exactly .025 of an inch.

6. Each line on the sleeve counts .001".

Each line on the hub counts .025".

You must add the numbers on the sleeve and the hub together to get the exact reading of the micrometer.

7. Read the micrometer shown here and fill in the exact reading.



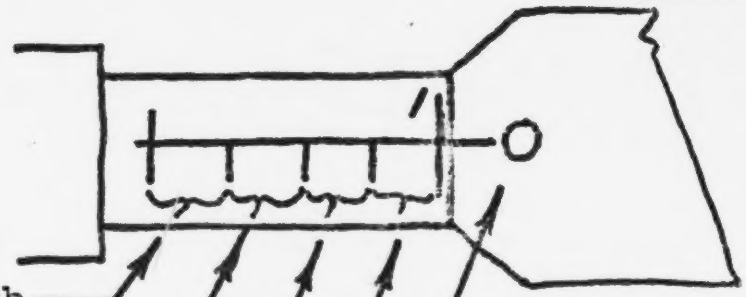
.025 Hub
.025 Hub
+ .010 Sleeve

Exact Reading ____

Tab #1

Turn up tab #1 and check your answer.

8. Read the micrometer shown here



____ Hub
____ Hub
____ Hub
____ Hub
____ Sleeve

Exact Reading ____

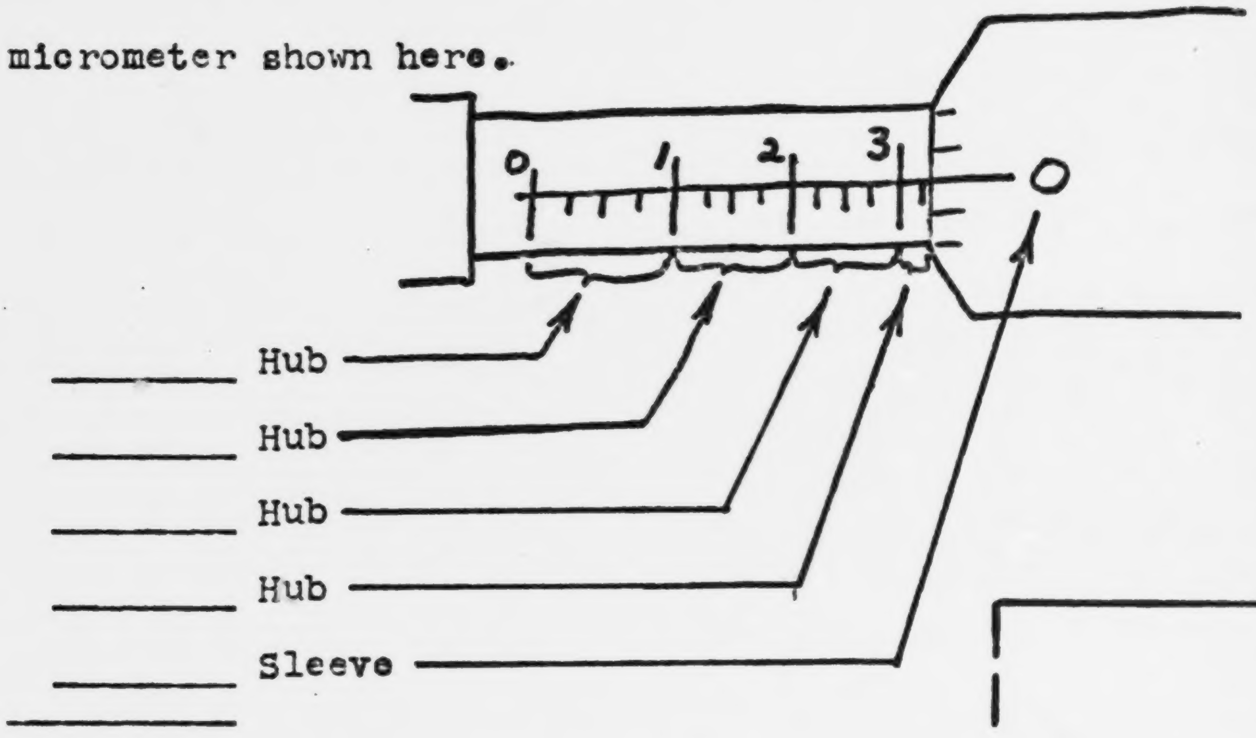
Tab #2

Turn up tab #2 and check your answer.

.060

.100

9. Read the micrometer shown here.

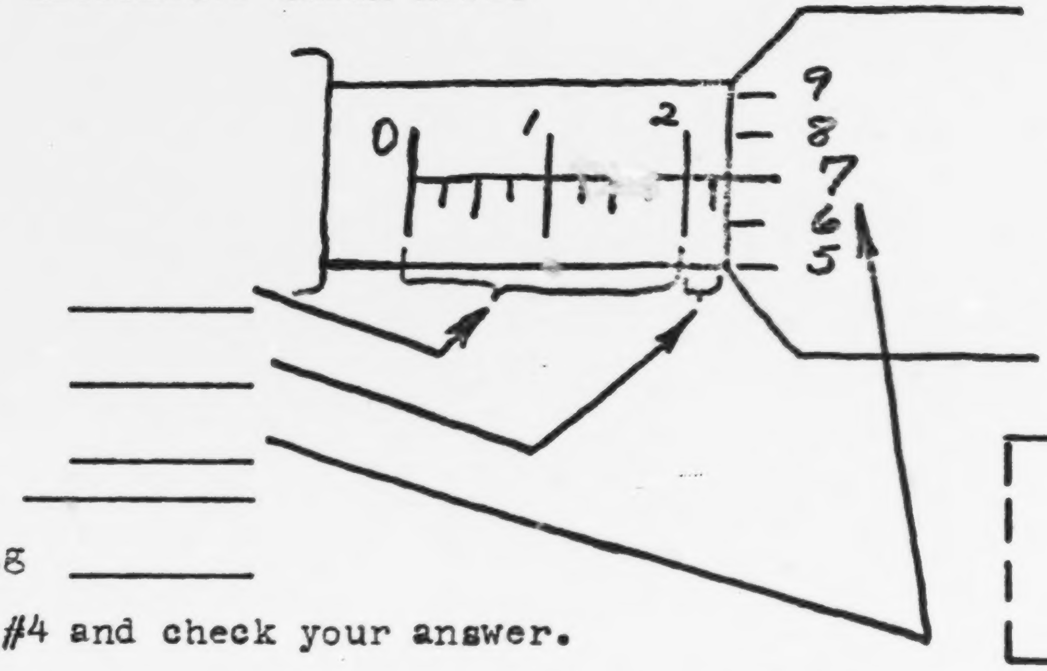


Exact Reading ________

Tab #3

Turn up tab #3 and check your answer.

10. Read the micrometer shown here.



Exact Reading ________

Tab #4

Turn up tab #4 and check your answer.

11. Micrometers come in different sizes. 0-1" is used for small objects.

A 0-1" micrometer can only measure objects smaller than 1".

All your readings on a 1" micrometer will start

| 0. | and then a reading |

A 1-2" micrometer can only measure objects larger than 1" and smaller than 2".

All your readings on a 1-2" micrometer start

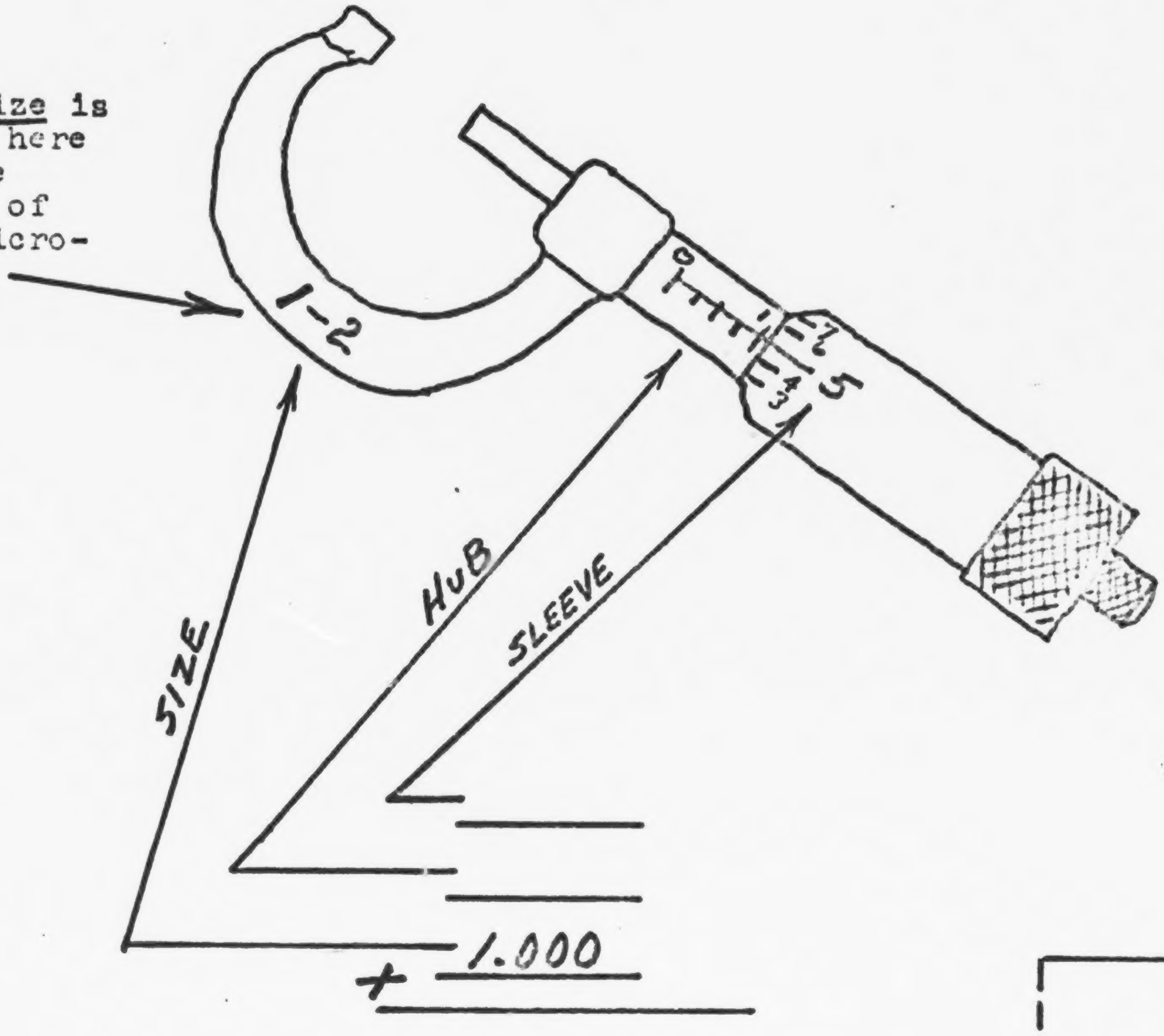
| 1. | and then a reading |

.325

.232

12. Read the 1-2" micrometer shown here.

The size is shown here on the frame of the micrometer


1-2
0
1
2
4
3
5
HUB
SLEEVE
SIZE
1.000
+

Exact Reading ______

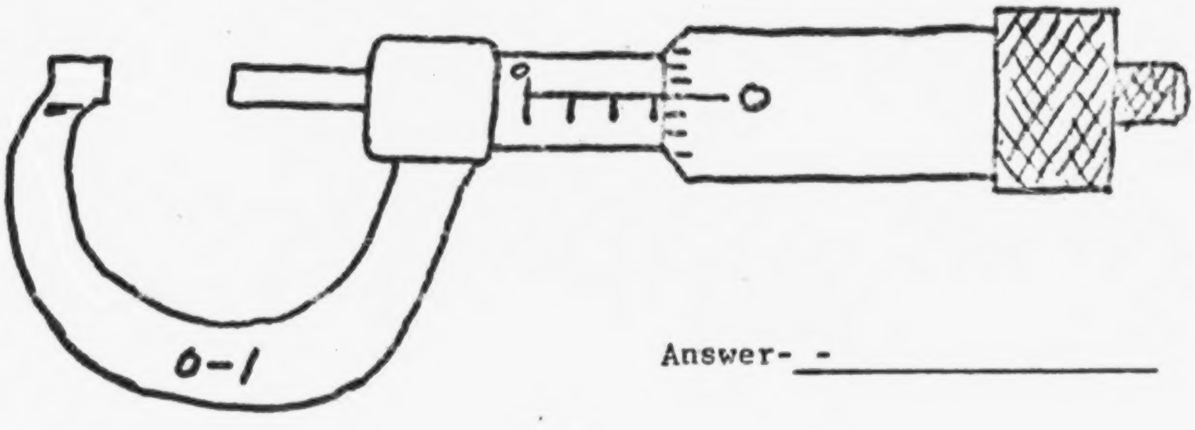
Tab #5

1.105

Post Test:

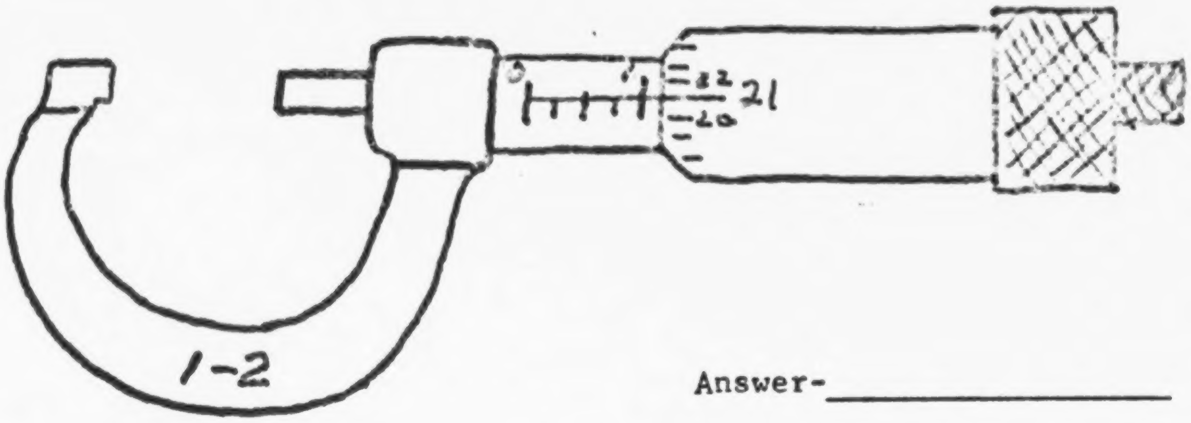
Read the measurements shown on the following micrometers.

1.



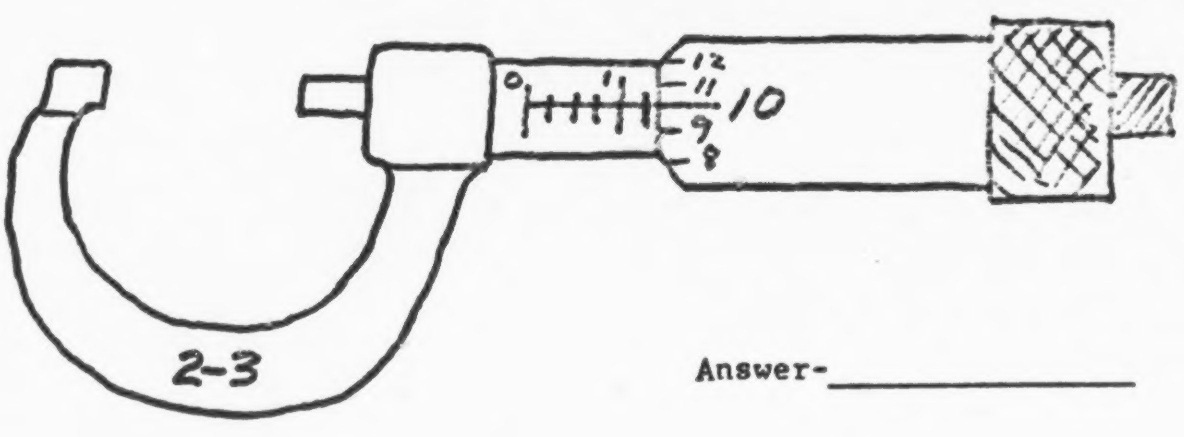
Answer-____________________

2.


0
1
22
21
20
1-2

Answer-____________________

3.


0
1
12
11
10
9
8
2-3

Answer-__________________

Sign your name here ______________________________ and turn this paper into your instructor.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-42

Pages 3, 4 and 5 of this package must be cut to facilitate folding. Cut on the horizontal solid lines for each tab so that each tab may be folded up individually as the student checks his answers.

Answers to Post Test.

1. .075

2. 1.121

3. 2.135

FOR THE STUDENT

NO. H-43

SERVICE

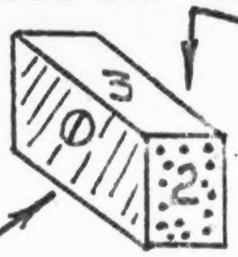
READING TWO AND THREE VIEW DRAWINGS

Objective:

Given two objects, you will be able to correctly sketch the front, side, and top views or front and side views of the objects.

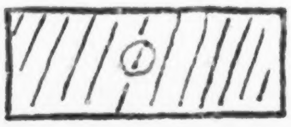
Activity:

1. A picture of an object might look like this:



2. Look at the object from the front

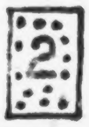
and you would see this →



this is called a Front View

3. Look at the object from the end

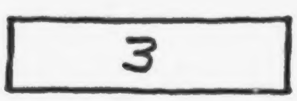
and you would see this →



this is called an End View or Side View

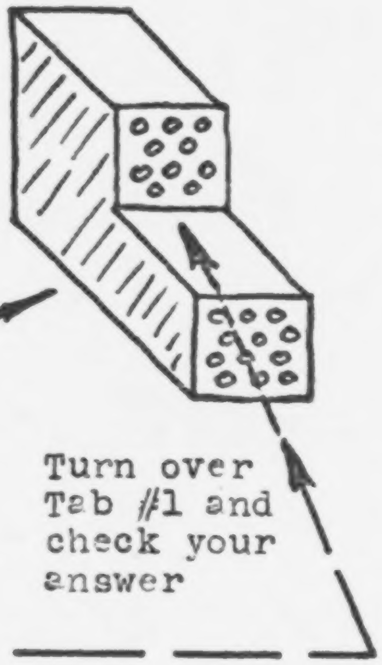
4. Look at the object from the top

and you would see this →



this is called a Top View

5. This is a picture of an object.



Draw a front view

Ans.____________ Turn over Tab #1 and check your answer

Tab #1

6. Draw an end view

Ans.____________ Turn over Tab #2 and check your answer

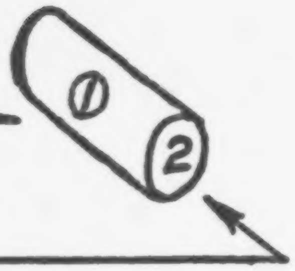
Tab #2

7. Draw a top view

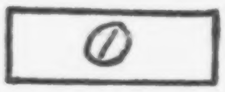
Ans.____________ Turn over Tab #3 and check your answer

Tab #3

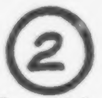
8. This is a picture of an object.



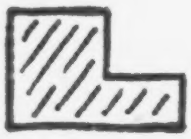
9. A front view looks like this

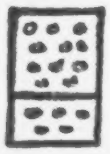


10. An end view looks like this

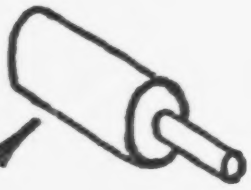


11. Because this object is round, the top view is not needed. The top view would look just like the front view.





12. This is a picture of an object.



Draw a front view

Ans._______________

Turn over Tab # 4 and check your answer

Tab #4

Draw an end or side view

Ans._______________

Turn over Tab #5 and check your answer

Tab #5

Post Test:

1. Get 2 objects from your instructor.
2. Draw the necessary 2 or 3 views of each object and record the number located on each object in the upper left hand corner of the answer spaces below.

No.____	No.____

3. Sign your name below and turn this sheet into your instructor.

____

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-43

1. For the Post Test in this package, the student will need two objects marked with numbers for identification purposes. I would recommend that about six different objects be constructed using a combination of round and rectangular shapes.

2. Pages 2 and 3 of this package must be cut to facilitate folding. Cut on the horizontal solid lines for each tab so that each tab may be folded up individually as the student checks his answers.

FOR THE TEACHER NO. H-44

SERVICE

USE OF A MICROMETER

Objective:

Given a micrometer, several feeler gages, and 2 pieces of unmarked stock, the student will be able to measure with a micrometer so that a reading accurate to .001 of an inch can be obtained.

Prerequisite Skills:

Students should complete package NO. H-42 before starting this activity.

Activity:

1. Provide the students with an outside micrometer (0-1") and 4 feeler gages. Each feeler gage should be marked in thousandths of an inch accurate to .001.
2. The student should place a feeler gage between the anvil and spindle of the micrometer and set the micrometer so that it reads the exact number marked on the feeler gage. Now, the student should note the proper feeling of a properly adjusted micrometer.
3. The above procedure should be repeated on the 3 remaining feeler gages.
4. Now, the student should be given at least 2 pieces of unmarked round stock under 1" diameter.
5. The student should take micrometer readings on each of them and record these readings to be checked for accuracy.
6. This procedure should be repeated until the student can successfully take readings with a micrometer on unmarked stock.

FOR THE STUDENT

NO. H-45

SERVICE

CRANKSHAFT INSPECTION

Objective:

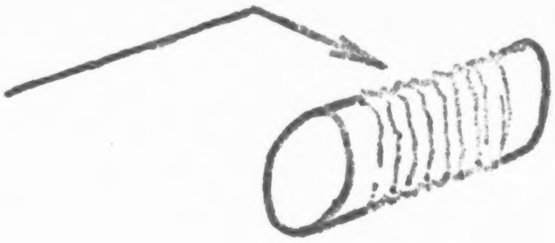
Given a used crankshaft and micrometers, you will be able to check the journals on the crankshaft and determine if they need machining or are good for further use without machining.

Prerequisite Skills:

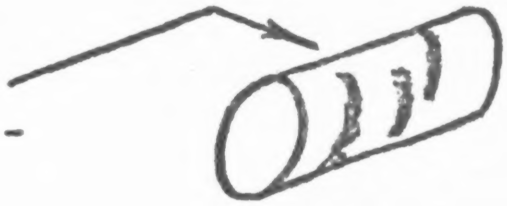
Micrometer packages #42, 43, and 44. You must know the parts of the crankshaft, such as the main journal and crankpin.

Activity:

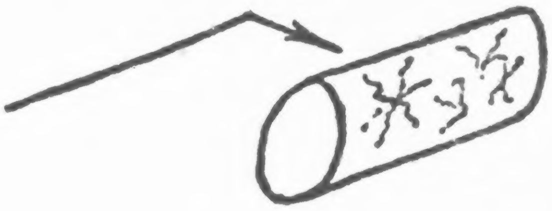
1. Get micrometers and crankshaft and take them to your work station.
2. Carefully inspect (visual inspection) all the journals of the crankshaft.
   - A. Look for scratches or grooves on the journals - this condition is caused by dirt or other foreign particles in the lubrication system.



   - B. Look for blue color on the running surface of the journals - this is caused by overheating.



   - C. Look for surface cracks - this is caused by overheating and possible fatigue.



3. If any of the above conditions are found, the crankshaft must be machined before it can be used again.

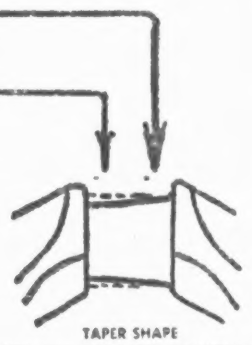
4. Using a micrometer, measure a journal and record the results for each section outlined in A, B, C, and D.

A. Check for excessive taper.

1.__________ Take first reading here

2.__________ Take second reading here

3.__________ Record the difference between the first and second readings. This gives you the maximum taper reading.


TAPER SHAPE
OUT-OF-SHAPE JOURNAL

Maximum Taper Variation Allowed

.0002" up to 1" long journal
.0004" for 1" to 2" long journal
.0005" for 2" or longer journal

If the taper variation found by your micrometer readings is over the maximum variation allowed, the crankshaft must be machined before it is put back into service.

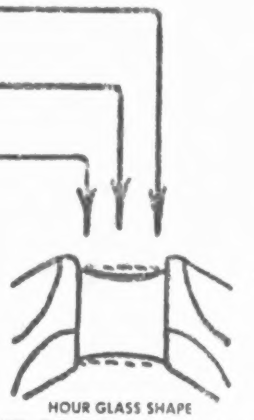
B. Check for excessive hour glass shape.

1.__________ Take first reading here

2.__________ Take second reading here

3.__________ Take third reading here

4.__________ Record the largest difference between readings 1 and 2 or 2 and 3. This is your maximum hour glass variation reading.


HOUR GLASS SHAPE
OUT-OF-SHAPE JOURNAL

Maximum Hour Glass Variation Allowed

.0002" for up to 1" long journal
.0004" for 1" to 2" long journal
.0005" for 2" or longer journal

If the hour glass variation found by your micrometer readings is over the maximum variation allowed, the crankshaft must be machined before it is put back into service.

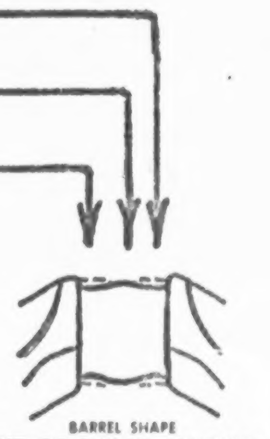
C. Check for excessive barrel shape.

1.__________ Take first reading here

2.__________ Take second reading here

3.__________ Take third reading here

4.__________ Record the largest difference between readings 1 and 2 or 2 and 3. This is your maximum barrel variation reading.



BARREL SHAPE
OUT-OF-SHAPE JOURNAL

Maximum Barrel Variation Allowed

.0002" for up to 1" long journal
.0004" for 1" to 2" long journal
.0005" for 2" or longer journal

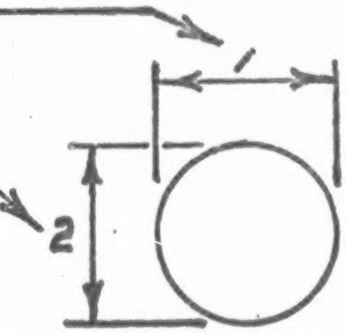
If the barrel variation found by your micrometer readings is over the maximum variation allowed, the crankshaft must be machined before it is put back into service.

D. Check for excessive out-of-round shape.

1.__________Take first reading here

2.__________Take second reading here

3.__________Record the difference between first and second readings. This gives you the maximum out-of-round reading.



Maximum Out-Of-Round Variation Allowed

.002"

If the out-of-round variation found by your micrometer reading is over the maximum variation allowed, the crankshaft must be machined before it is put back into service.

5. Repeat step #4 for each journal on the crankshaft (both main bearing journals and crankpin journals).

6. Now, record your results by circling the correct answer below:
   A. Needs machining

   B. Good for further use without machining

   Record the number on the crankshaft you used here __________.

FOR THE STUDENT

SERVICE

BEARING FAILURE ANALYSIS

Objective:

Given pictures showing 4 different bearing failure problems, you will be able to label the pictures stating the reason for each bearing failure.

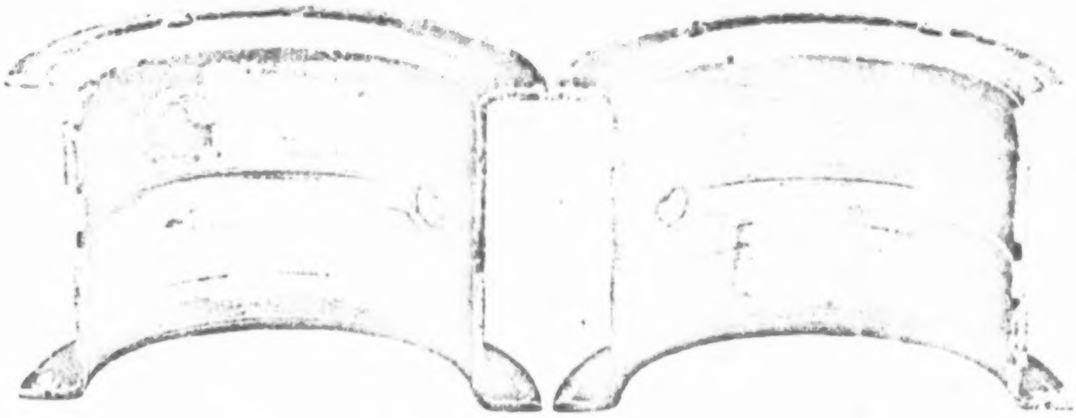
Activity:

1. Locate and set up the slide show called "Bearing Failure Analysis". (Get handout sheet "A" from your instructor).
2. Look at the slide show and label each picture on the hand out sheet with the reason for bearing failure.
3. Now, get the test (handout sheet "B") from your instructor and label each picture with the reason for bearing failure.

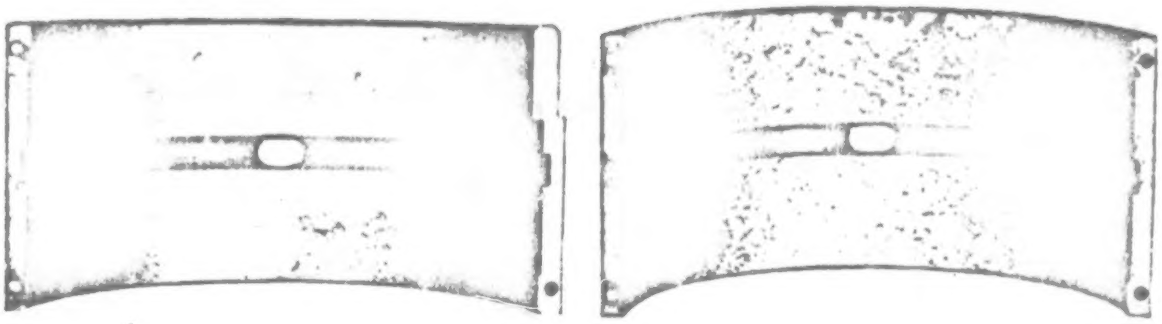
HANDOUT SHEET "A" FOR PACKAGE NO. H-46

Label each picture using only one of the reasons for bearing failure.

1. Dirty air or dirty oil
2. Misalignment
3. Oil starvation
4. Corrosion
5. Fatigue
6. Overloading



1. Answer ______________________

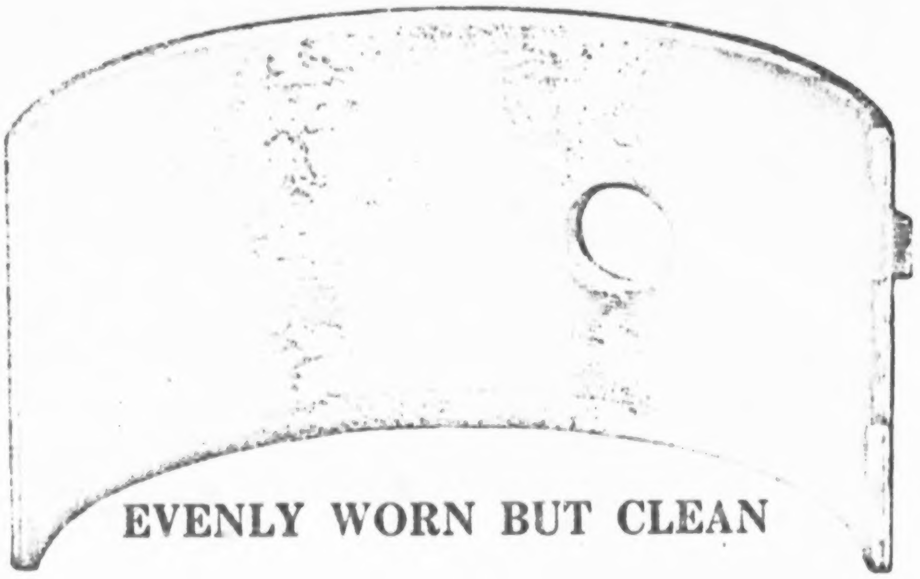


2. Answer ______________________

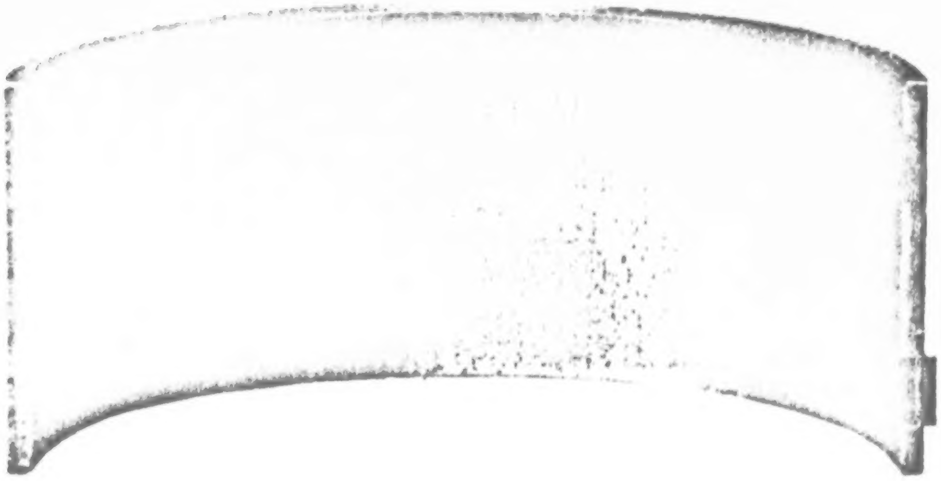
HANDOUT SHEET "B" FOR PACKAGE NO. H-46

Label each picture using only one of the reasons for bearing failure.

1. Dirty air or dirty oil	4. Corrosion
2. Misalignment	5. Fatigue
3. Oil starvation	6. Overloading

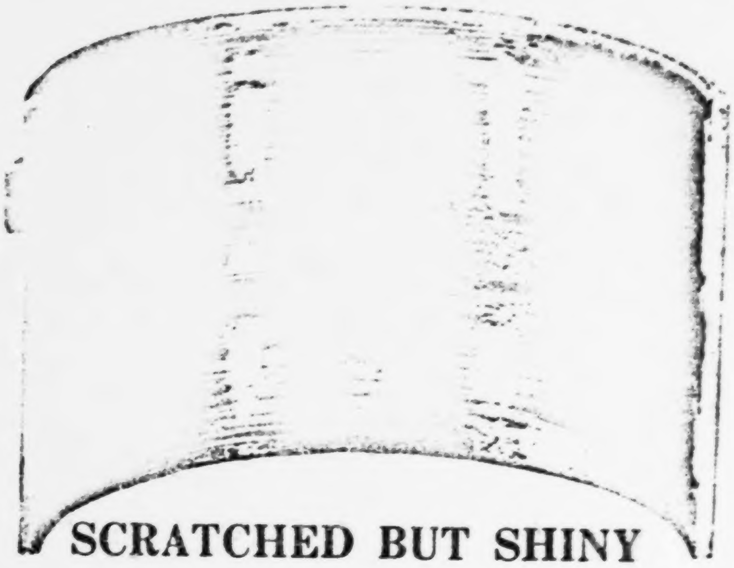


1. Answer ______________________



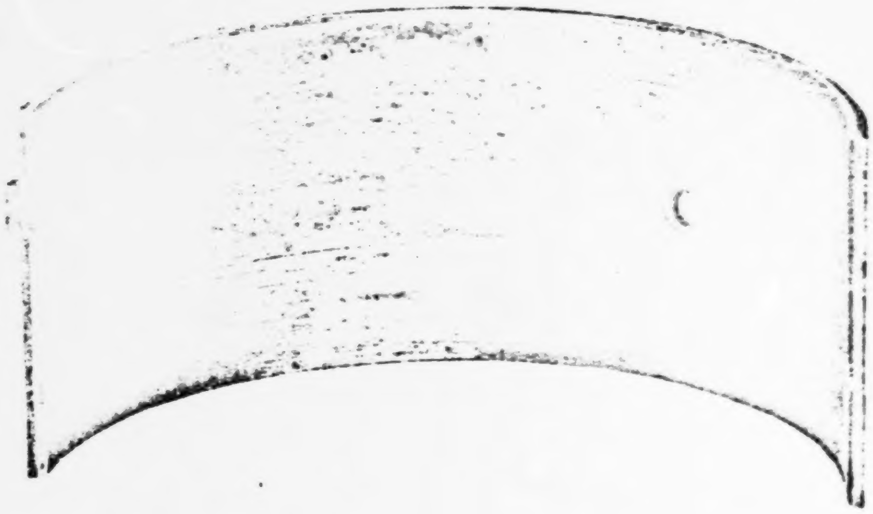
2. Answer ____________________

HANDOUT SHEET "B" CONTINUED FOR PACKAGE NO. H-46



SCRATCHED BUT SHINY

3. Answer ______________________



4. Answer ______________________

Sign your name here ______________________ and return this paper to your instructor.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-46

Answers to handout sheet "A"

1. Misalignment
2. Overloading

Answers to test (handout sheet "B")

1. Fatigue
2. Corrosion
3. Oil starvation
4. Dirty air or dirty oil

A reference chart is available from Clevite Corporation
Cleveland Graphite Bronze Division
17000 St. Clair Avenue
Cleveland, Ohio 44110

Slide Show on "Bearing Failure Analysis"

Slide Number	Visual
1.	Focus slide.
2.	Title slide-"Bearing Failure Analysis".
3.	Picture showing bearing damaged because of dirt.
4.	Picture showing cause of dirt damage.
5.	Picture showing damage because of misalignment.
6.	Picture showing cause of misalignment damage.
7.	Picture showing damage because of oil starvation.
8.	Picture showing cause of oil starvation.

Slide Number	Visual
9.	Picture showing damage because of corrosion.
10.	Picture showing cause of corrosion.
11.	Picture showing damage because of fatigue.
12.	Picture showing cause of fatigue.
13.	Picture showing damage because of overloading.
14.	Picture showing cause of overloading.
15.	The End.

SERVICE

BATTERY CAPACITY TEST

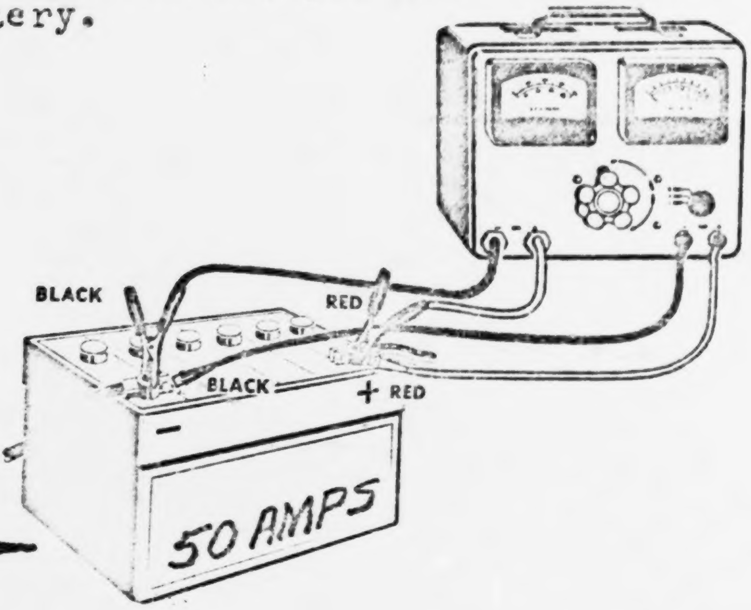
Objective:

Given a battery and battery starter tester, you will be able to check the capacity of a battery.

Activity:

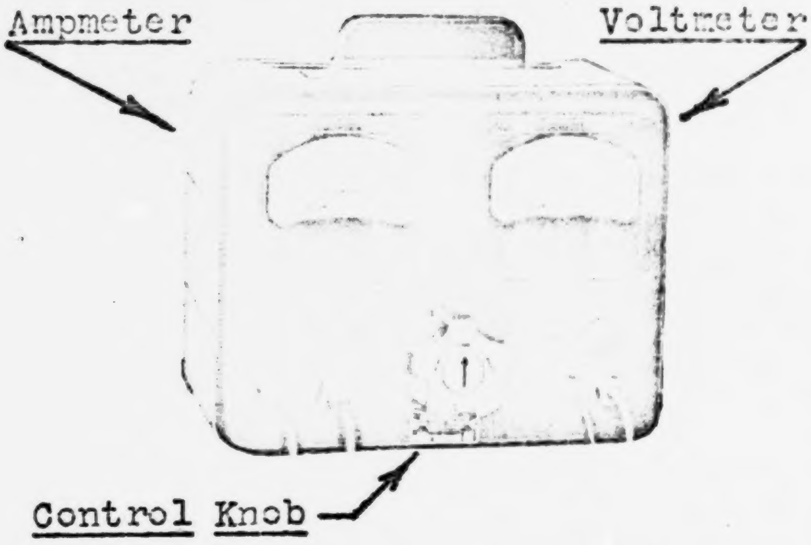
1. Get a battery starter tester and connect it to the battery as shown here -

2. Look on the battery for the amp hour rating as shown here



3. Adjust the control knob so that the ampmeter reads 3 x the amp hour rating on the battery.

4. Wait 15 seconds - then read voltmeter and turn control knob off immediately ("off" means ampmeter reads zero).



5. The voltmeter reading you got in step 4 must not drop below 9.6 volts for a 12 volts battery or below 4.8 volts for a 6 volt battery.

6. If the voltage reading falls below the required specification given above, you should charge the battery, then retest. If the reading is still low the battery is in poor condition and should be replaced.

SERVICE

EXPOSURE TO A JOB

Objective:

Given a detailed outline, the student will examine a job by investigating the various aspects of that job. Then the student will discuss the job in an interview with his instructor to develop a better knowledge on which he may base his selection of a future occupation.

Activity:

1. The students should be asked to identify a job they feel they would like to have if they had a choice. Here, it would be advisable to encourage the student to choose a job he would most like to hold regardless of his abilities at the present time. Remember to record these selections for future reference.

   Option - you may wish to assign a certain job to each student.

2. Introduce the detailed outline to all students involved after the jobs have been identified. You should then conduct a discussion of the outline and suggestions as to how the student should or could go about obtaining the information required. For example, I would recommend interviews and visits to see people at work where this is possible.

3. The students should schedule an interview with you to discuss and evaluate the results of their investigation. This interview might be carried on as though the student were applying for the job, followed by a general discussion.

STUDENT HANDOUT NO. H-48

EXPOSURE TO A JOB

Due Date ______________________

General Directions: Fill in the blanks on the following outline if they apply to the job you are investigating.

1. Name of job ______________________
2. Your name ______________________
3. List of references

A) List the names of the people you talked to	Name of the job they hold
1.	
2.	
3.	
4.	

B) List the name(s) of places or companies you visited.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________

C) List phamplets, books, or other ways by which you got information.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________

4. Define the job

A) List all the things this person does each day at work.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____
8. ____

B) List responsibilities such as men he has working for him or people he is responsible for.

1. ____
2. ____
3. ____
4. ____

5. List the kind of training required or needed to get this job and also the amount of training necessary.

Trade school
Apprenticeship
College
Background Experience
Other

Type of training needed?	How much training is necessary?
	(Years or hours)
	(Years or hours)

6. How much can you earn working at this job?

	Total of hourly-salary and commission
A) Highest salary or wage that is earned	________________
B) Lowest salary or wage that is earned	________________
C) Average salary or wage that is earned	________________

7. What kind of hours are required?

A) How many hours?

1. How many hours at work each day? ______

2. How much time is spent at home after work (homework)? ______

3. Total hours spent per day. ______

4. How many days per week does this job require? ______

5. Total hours spent per week? ______

B) Night or day shift? ______

C) How much time must be spent away from home traveling? ______

8. What kind of working conditions?

A) Type of dress and cost? ______

______

B) Health conditions (smoke, noise, dirty - dangers such as high climb, explosions, etc. - air conditioned, outdoor work, physical or metal pressure)?

______

______

______

C) Fringe benefits (extras) such as expense accounts, paid vacations, paid insurances, car supplied, etc.

______

______

______

9. Is this an important job? Yes or no and why?

______

______

______

______

10. Is this a fun job? Yes or no and why?

11. Do you want this job now? If yes, why?

12. Would you want this job 10 years from now? If yes, why?

12. When you have finished the investigation see your instructor to schedule an interview.

FOR THE STUDENT

NO. H-49

SERVICE

TESTING WELDS

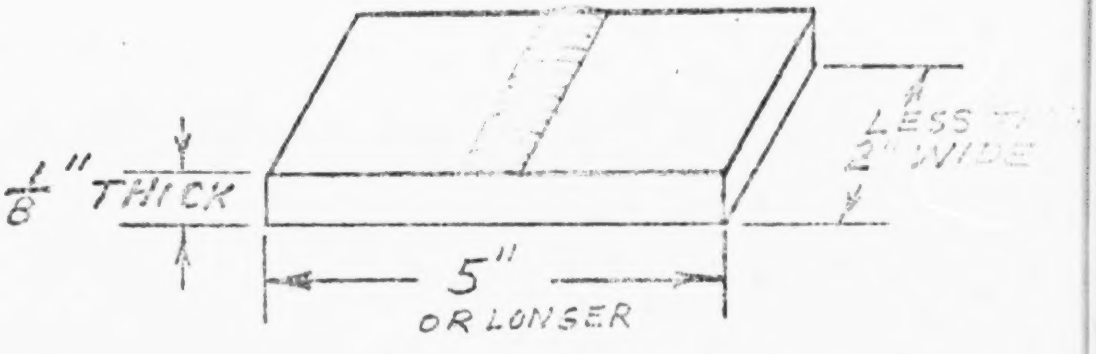
Objective:

Given several butt welds and a bend jig, you will be able to test the quality of a weld and label the weld good or bad.

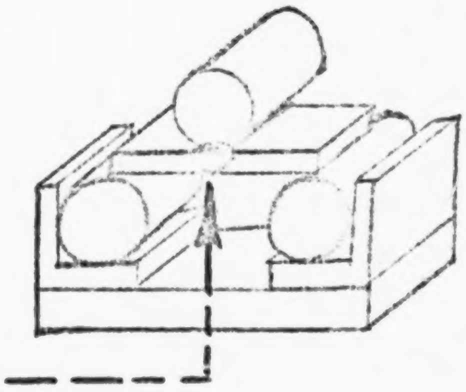
Activity:

1. Get welds to be tested, or use your own welds.

The welds to be tested must be the size shown here.

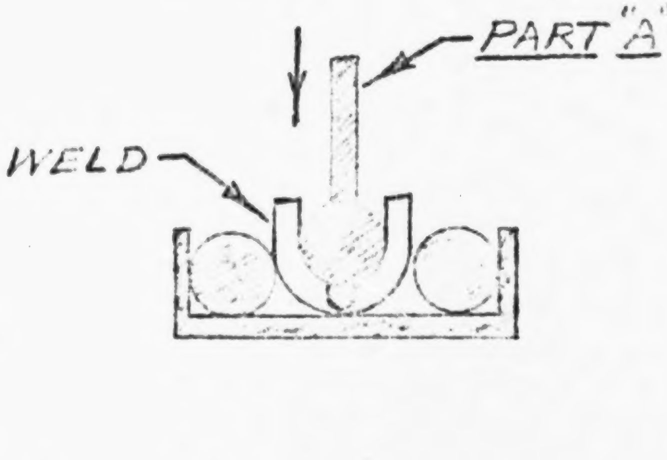


2. Place the weld in the bend jig as shown here - welded side up.



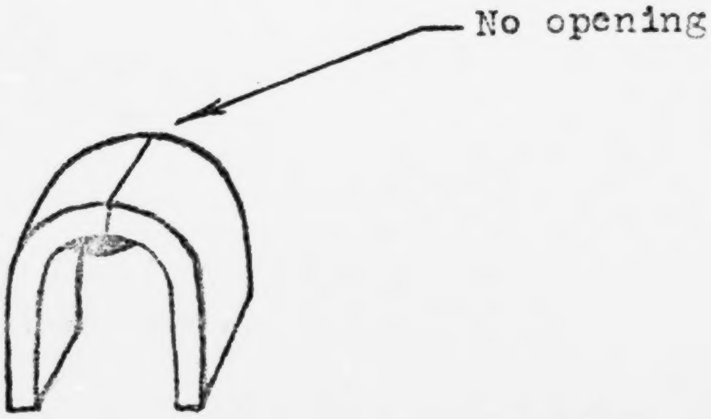
Make sure you center the weld in the bend jig.

3. Force Part "A" down to bend the welded metal into a U-shape as shown here.

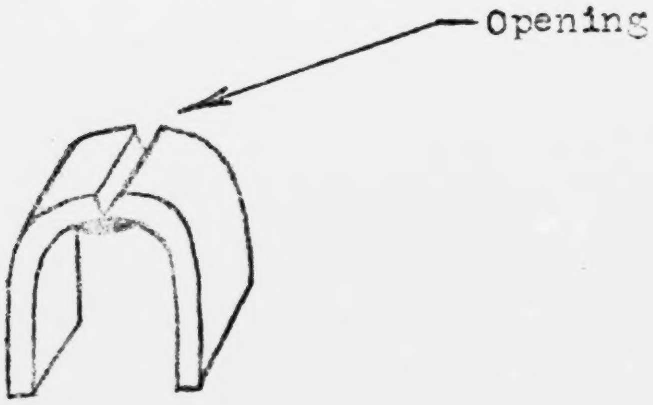


4. Remove the weld sample from the bend jig and examine the side opposite the welded side.

A good quality weld
looks like this -



A poor quality weld
looks like this -



5. Test several welds until you find welds you can label as follows:

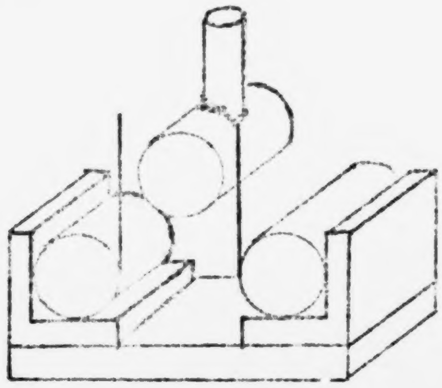
   1. One good quality weld

   2. One poor quality weld

6. Label these welds good or bad and write your name on them with chalk. Then turn them into your instructor.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE NO. H-49

You will need a bending device for this package. The following is a simple bending jig that can be easily constructed and adapted for use on an arbor press.



Detailed plans can be obtained from Hobart Brothers Company, Troy, Ohio.

The book to request is, Recommendations for Teaching Welding.

FOR THE STUDENT

NO.H-50

SERVICE

READING A TAP DRILL CHART

Objective:

Given the proper chart and a tap size, you will be able to find the drill size (number, letter or fraction) and decimal equivalent of the drill.

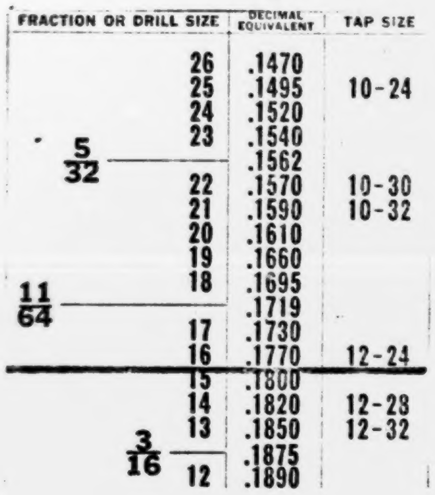
Activity:

1. A tap drill chart has 3 columns.
   - (A) Tap size
   - (B) Decimal equivalent
   - (C) Fraction or drill size

2. Look at the tap size column and find a 12-24 tap size.

3. Look at the fraction or drill size column and your drill size for a 12-24 tap is a number 16 drill.

4. Now, look at the decimal equivalent column. The decimal equivalent for the number 16 drill is .1770.



FRACTION OR DRILL SIZE		DECIMAL EQUIVALENT	TAP SIZE
	26	.1470	
	25	.1495	10-24
	24	.1520	
	23	.1540	
5/32		.1562	
	22	.1570	10-30
	21	.1590	10-32
	20	.1610	
	19	.1660	
	18	.1695	
11/64		.1719	
	17	.1730	
	16	.1770	12-24
	15	.1800	
	14	.1820	12-28
	13	.1850	12-32
3/16		.1875	
	12	.1890	

5. Using the chart below, find the following -

Tap drill size for a 1/2-13 tap size. ______________ Ans.

Decimal equivalent for a 1/8" drill. ______________ Ans.

Tap size for use with a 5/16" tap drill. ______________ Ans.

FRACTION OR DRILL SIZE	DECIMAL EQUIVALENT	TAP SIZE
NUMBER SIZE DRILLS 80	.0135	
79	.0145	
1/64	.0156	
78	.0160	
77	.0180	
76	.0200	
75	.0210	
74	.0225	
73	.0240	
72	.0250	
71	.0260	
70	.0280	
69	.0292	
68	.0310	
1/32	.0312	
67	.0320	
66	.0330	
65	.0350	
64	.0360	
63	.0370	
62	.0380	
61	.0390	
60	.0400	
59	.0410	
58	.0420	
57	.0430	
56	.0465	
3/64	.0469	0-80
55	.0520	
54	.0550	1-56
53	.0595	1-64, 72
1/16	.0625	
52	.0635	
51	.0670	
50	.0700	2-56, 64
49	.0730	
48	.0760	
5/64	.0781	
47	.0785	3-48
46	.0810	
45	.0820	3-56, 4-32
44	.0860	4-36
43	.0890	4-40
42	.0935	4-48
3/32	.0938	
41	.0960	
40	.0980	
39	.0995	
38	.1015	5-40
37	.1040	5-44
36	.1065	6-32
7/64	.1094	
35	.1100	
34	.1110	6-36
33	.1130	6-40
32	.1160	
31	.1200	
1/8	.1250	
30	.1285	
29	.1360	8-32, 36
28	.1405	8-40
9/64	.1406	
27	.1440	
26	.1470	
25	.1495	10-24
24	.1520	
23	.1540	
5/32	.1562	
22	.1570	10-30
21	.1590	10-32
20	.1610	
19	.1660	
18	.1695	
11/64	.1719	
17	.1730	
16	.1770	12-24
15	.1800	
14	.1820	12-28
13	.1850	12-32
3/16	.1875	
12	.1890	
11	.1910	
10	.1935	
9	.1960	
8	.1990	
7	.2010	1/4-20
13/64	.2031	
6	.2040	
5	.2055	
4	.2090	
3	.2130	1/4-28
7/32	.2188	
2	.2210	
1	.2280	
LETTER SIZE DRILLS A	.2340	
15/64	.2344	
B	.2380	
C	.2420	
D	.2460	
1/4 E	.2500	
F	.2570	5/16-18
G	.2610	
17/64	.2656	
H	.2660	
I	.2720	5/16-24
J	.2770	
K	.2810	
9/32	.2812	
L	.2900	
M	.2950	
19/64	.2969	
N	.3020	
5/16	.3125	3/8-16
O	.3160	
P	.3230	
21/64	.3281	
Q	.3320	3/8-24
R	.3390	
11/32	.3438	
S	.3480	
T	.3580	
23/64	.3594	
U	.3680	7/16-14
3/8	.3750	
V	.3770	
W	.3860	
25/64	.3906	7/16-20
X	.3970	
Y	.4040	
13/32	.4062	
Z	.4130	
27/64	.4219	1/2-13
7/16	.4375	
29/64	.4531	1/2-20
15/32	.4688	
31/64	.4844	9/16-12
1/2	.5000	
33/64	.5156	9/16-18
17/32	.5312	5/8-11
35/64	.5469	
9/16	.5625	
37/64	.5781	5/8-18
19/32	.5938	11/16-11
39/64	.6094	
5/8	.6250	11/16-16
41/64	.6406	
21/32	.6562	3/4-10
43/64	.6719	
11/16	.6875	3/4-16
45/64	.7031	
23/32	.7188	
47/64	.7344	
3/4	.7500	
49/64	.7656	7/8-9
25/32	.7812	
51/64	.7969	
13/16	.8125	7/8-14
53/64	.8281	
27/32	.8438	
55/64	.8594	
7/8	.8750	1-8
57/64	.8906	
29/32	.9062	
59/64	.9219	
15/16	.9375	1-12, 14
61/64	.9531	
31/32	.9688	
63/64	.9844	1 1/8-7
1	1.0000	
1 3/64	1.0469	1 1/8-12
1 7/64	1.1094	1 1/4-7
1 1/8	1.1250	
1 11/64	1.1719	1 1/4-12
1 7/32	1.2188	1 3/8-6
1 1/4	1.2500	
1 19/64	1.2969	1 3/8-12
1 11/32	1.3438	1 1/2-6
1 3/8	1.3750	
1 27/64	1.4219	1 1/2-12
1 1/2	1.5000	

PIPE THREAD SIZES

THREAD	DRILL	THREAD	DRILL
1/8-27	R	1 1/2-11 1/2	1 47/64
1/4-18	7/16	2-11 1/2	2 7/32
3/8-18	37/64	2 1/2-8	2 5/8
1/2-14	23/32	3-8	3 1/4
3/4-14	59/64	3 1/2-8	3 3/4
1-11 1/2	1 5/32	4-8	4 1/4
1 1/4-11 1/2	1 1/2		

6. Sign your name and turn this paper into your instructor.

____

HAND TOOLS AND SIMPLE MACHINES

MAKING ANGULAR CUTS WITH A MITRE BOX

Objective:

Using three pieces of scrap wood from the scrap lumber rack or box, a mitre box, and a saw you will cut the wood to angles of 45 degrees, 60 degrees and 90 degrees.

Activity:

1. Get three pieces of scrap wood from lumber rack or box.
2. Get the mitre box and back saw with the help of your teacher aide or teacher, if needed.
3. Using the mitre box, back saw, and scrap wood, demonstrate to the teacher aide or teacher your ability to perform cuts of 45 degrees, 60 degrees and 90 degrees.
    - (A) If successful you are done.
    - (B) If unsuccessful go to number four.
4. Take the slide presentation "The Back Saw" to a study carrel and view the materials by yourself.
5. Using the mitre box, back saw and scrap wood, practice the cuts demonstrated in the slide presentation.
6. When you feel you are ready try to do number three again.
7. If you are still unsuccessful, repeat steps 4 and 5 untill you are able to successfully complete step number three.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-5

1. For this package the student will need:

   A. Back saw
   B. Mitre box
   C. Scrap wood

2. Concomitant media:

Super 8mm Film Loops demonstrate all the basic hand tool skills and operations normally taught in a woodworking course from the simplest aspects of what specific tools are used for, to the more advanced techniques of laying out and cutting a gain, cutting a tenon, and mitering a picture frame.

Film Loop can be purchased from:

McGraw-Hill Films
A Division of McGraw-Hill Book Co.
330 West 42nd Street
New York 36, New York 10036

CODE 698701
Set of 14 films-color-$255
Individual films-$20
The Back Saw (698713)

No. I-6

FOR THE STUDENT

HAND TOOLS AND SIMPLE MACHINES

HAND SAW USAGE

Objective: Using a hand saw you will make a straight cut (+ - 1/8).

Activity: 1. Using a rip or crosscut saw, make a straight cut (+ - 1/8"), for your teacher or teacher aide.
   (A) If successful you are done.
   (B) If unsuccessful go to number two.

2. Take the 8mm presentation "Using a Crosscut Saw" to a study carrel where you can view the materials by yourself.

3. Using the hand saw, practice cutting as demonstrated in the slide presentation.

4. When you feel you can do this perform number one.

5. If unsuccessful repeat two and three until you are able to successfully complete number one.

NO I-6

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE

Concomitant media:

Super 8mm film loops demonstrate all the basic hand tool skills and operations normally taught in a woodworking course, from the simpliest aspects of what specific tools are used for, to the more advanced techniques.

Film loop can be purchased from:

McGraw-Hill Films
A division of McGraw-Hill Book Co.
330 West 42nd Street
New York 36, New York 10036

No I-8

FOR THE STUDENT

HAND TOOLS AND SIMPLE MACHINES

POSITIONING WORK

Objective: You will position work for cutting using the power hack saw.

Activity:

1. Using a power hack saw, position the work for cutting; teacher or teacher aide will check position.
   (A) If successful you are done.
   (B) If unsuccessful go to number two.

2. Take the 8mm film loop presentation "Hand and Power Hack Saws" to a study carrel where you can view the material by yourself.

3. Practice positioning work as shown in slide presentation.
   (C) If successful perform number one.
   (D) If unsuccessful repeat two and three until you are able to successful position work.

No. I-8

TEACHER REFERENCE TEXT MEDIA AND STUDENT PACKAGE

1. Concomitant Media:

Super 8mm film loops demonstrate all the basic hand tool skills and operations normally taught in a woodworking course, from the simplest aspects of what specific tools are used for, to the more advanced technique.

Film loop can be purchased from:

McGraw-Hill Films
A division of McGraw-Hill Book Co.
330 West 42nd Street
New York 36, New York 10036

FOR THE STUDENT

HAND TOOLS AND SIMPLE MACHINES

SELECTING TOOLS

Objective:

Depending on the type of cut, you will select the correct power saw.

Activity:

1. You will select the correct power saw in the presence of your teacher or teacher aide.
    - A. If successful you are done.
    - B. If unsuccessful go to number three.
2. Take the folder from the file cabinet labeled "Types of Cuts" and try to find the cut you want listed to left under the column headed "cuts".
    - C. If successful follow dots across untill you reach the column to the right that gives the power saw needed for that operation.
3. Repeat number two.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-9

1. This information should be in folder that is labeled "Types of Cuts"

CUTS	POWER TOOL NEEDED
1. Ripping	Circular Saw or Radial Saw
2. Crosscutting	Circular Saw or Radial Saw
3. Grooves	Circular Saw
4. Rabbets	Circular Saw
5. Dadoes	Circular or Radial Saw
6. Tenons	Circular Saw
7. Miters	Circular Saw
8. Compound Miters	Radial Saw
9. Tapers	Circular Saw
10. Curves	Jig or Band Saw

FOR THE STUDENT No. I-11

HAND TOOLS AND SIMPLE MACHINES

BORING TOOLS IDENTIFICATION

Objective:

Given pictures of a hand drill, electric drill, hand brace, and drill press, you will name each tool for your teacher or teacher aide.

Activity:

1. Take the set of picturesnamed "boring tools", and give each tool a name. Turn the picture over and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE

No. I-11

1. For this package the student will need:

    (A) Four pieces of cardboard. (8" x 6")

    (B) Pictures of the following tools. (5" x 7")

        1. Hand drill
        2. Electric drill
        3. Hand brace
        4. Drill press

    (C) Folder with the following words on the front.

        1. Boring tools (Large letters)

2. Explanation:

Pictures should be attached to cardboard with the name of each tool on the back of the cardboard. The entire card should be laminated and placed in the folder.

FOR THE STUDENT No. I-12

HAND TOOLS AND SIMPLE MACHINES

BORING CUTTING TOOLS IDENTIFICATION

Objective:

Given pictures of an auger bit, speed bit, straight shank drill, taper shank drill, expansion bit, counter bore and compound bit, you will name tool for your teacher or teacher aide.

Activity:

1. Take the set of pictures named "boring cutting tools", and give each tool a name. Turn the picture over and read the correct name on the back to see if you are correct.

2. Repeat untill you can name all tools from memory.

3. Go to your tool panel and find these tools.

4. Name them for your teacher aide.

TEACHER REFERENCE INFORMATIONFOR STUDENT PACKAGE No. I-12

1. For this package the student will need:

   (A) Seven pieces of cardboard. (8" x 6")

   (B) Pictures of the following tools. (5" x 7")

      1. Auger bit
      2. Speed bore bit
      3. Straight shank drill
      4. Taper shank drill
      5. Expansion bit
      6. Counter bore
      7. Compound bit

   (C) Folder with the following words on the front.

      1. Boring cutting tools (Large letters)

2. Explanation:

Pictures should be attached to cardboard with the name of each tool on the back of the cardboard. The entire card should be laminated and placed in the folder.

FOR THE STUDENT

No. I-16

HAND TOOLS AND SIMPLE MACHINES

DRILLING

Objective:

Given a ratchet brace, an auger bit (½") wood, and this package, you will bore a ¼" diameter hole without splitting the wood and using safe procedures.

Activity:

1. If you think you can use the ratchet brace, get some wood, and an auger bit (½") and demonstrate to the teacher or teacher aide your ability to bore a a hole.

    (A) If successful you are done.

    (B) If unsuccessful, go to number two.

2. Take the 8mm projector and review the film loop "How to Drill a Hole With Brace and Bit".

3. Repeat until you are sure you can bore a hole using brace and bit.

4. Perform number one.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-16

1. Film loop can be purchased:

The Walden Film Corporation
39 East 31st Street
New York, New york 10018

FOR THE STUDENT

HAND TOOLS AND SIMPLE MACHINES

METALWORKING PUNCHES IDENTIFICATION

Objective:

Upon completion of this package you will be able to identify six metalworking punches, and state the use of each.

Activity:

1. View the transparency on metalworking punches included in this package. Notice the design of each punch. Each punch is used for a different operation, as described below.

2. Now view each punch, A thru F, and read the specific characteristics and use of each.

   A. Solid Punch - used to punch holes for rivets. The punches are numbered according to size from 6 to 10. Some companies letter the punches from B (3/32") to I (3/8"). Each number fits a certain size of rivet. For example, a No. 8 punch is made for 2-pound rivets. See Table, Fig. 1.

   B. Hollow Punch - used to punch holes larger than those cut with a solid punch. They will cut holes 1/4 to 3 inches in diameter, in sizes varying by 1/8 inch.

   C. Center Punch - used to enlarge prick-punch marks, so that a drill will start easily and correctly. The point of a center punch is ground to an angle of 90 degrees.

   D. Pin Punch - used to drive out cotter pins and tapered pins. These pins should first be loosened with a drift punch and then driven out with the pin punch. Notice this punch has a straight end.

   E. Drift Punch - used to arrange holes in a straight line and to drive out pins. It has a smooth and tapered end, and is sometimes called a tapered punch.

   F. Prick Punch - used to make the first marks locating holes and other points needing machining. It's point is ground to a sharp angle of about 30 degrees.

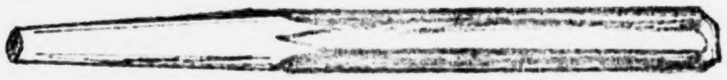
3. When you have finished viewing and reading the information about the punches, take the POST TEST. Read the directions for the test.

Directions for POST TEST: On a separate sheet of paper, name and write the use of each punch. When finished turn test in to your teacher for checking.

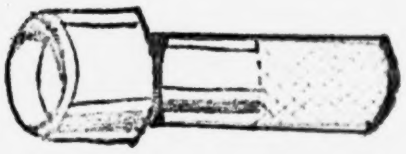
Table, Fig. 1. GUIDE FOR SELECTING SOLID PUNCHES

Gauge of Metal	Letter	Number	Size of Rivet	Number of Rivet
30	B	10	10 to 12 oz.	8
28	C	9	14 to 1 lb.	7
26	C	9	1 lb.	7
24	D	7 or 8	2 lb.	5
22	D	7 or 8	2½ lb.	5
20	E	6	3 lb.	4

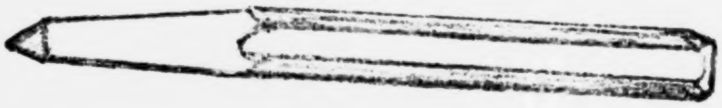
METALWORKING PUNCHES



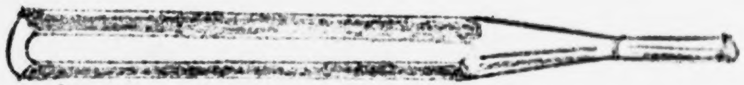
A. ______________________



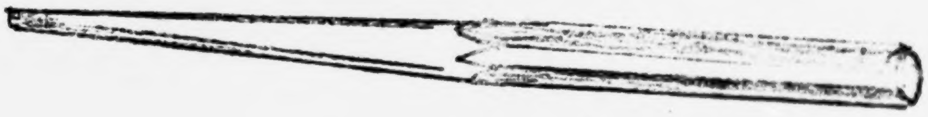
B. ______________________



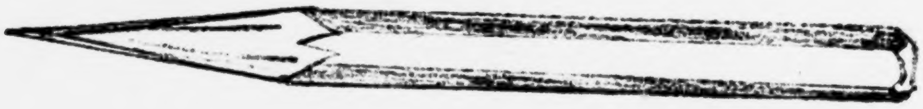
C. ______________________



D. ______________________



E. ______________________



F. ______________________

FOR THE STUDENT

No. I-29

HAND TOOLS AND SIMPLE MACHINES

POWER HAND TOOLS IDENTIFICATION

Objective:

Given pictures of a belt sander, finishing sander, router, saber saw, and hand circular saw, you will name each tool for your teacher or teacher aide.

Activity:

1. Take the set of pictures named "power hand tools", and give each tool a name. Turn the pictures over and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-29

1. For this package the student will need:

    (A) Five pieces of cardboard. (8" x6")

    (B) Pictures of the following tools. (5" x 7")

        1. Belt sander

        2. Finishing sander

        3. Router

        4. Saber saw

        5. Hand circular saw

    (C) Folder with the following words on the fornt.

        1. Power hand tools (Large letters)

2. Explanation:

Pictures should be attached to cardboard with the name of each tool on the back of the cardboard. The entire card laminated and placed in the folder.

FOR THE STUDENT

No. I-46

HAND TOOLS AND SIMPLE MACHINES

HAMMERS IDENTIFICATION

Objective:

Given pictures of a claw hammer, ball peen hammer, wood mallet, rawhide mallet, rubber mallet, plastic mallet and riveting hammer, you will name each tool for your teacher or teacher aide.

Activity:

1. Take the set of pictures named hammers and give each tool a name. Turn the pictures over and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-46

1. For this package the student will need:
   - (A) Seven pieces of cardboard. (8" x 6")
   - (B) Pictures of the following tools. (5" x 7")
     1. Claw hammer
     2. Ball peen hammer
     3. Wood mallet
     4. Rawhide mallet
     5. Rubber mallet
     6. Plastic mallet
     7. Riveting hammer
   - (C) Folder with the following words on the front.
     1. Hammers

2. Explanation:

Pictures should be attached to cardboard with the name of each tool on the back of the cardboard. The entire card laminated and placed in the folder.

FOR THE STUDENT No. I -58

HAND TOOLS AND SIMPLE MACHINES

PLANES IDENTIFICATION

Objective:

Given a picture of a block plane, bench plane, and jack plane, you will name each one for your teacher or teacher aide.

Activity:

1. Take the set of pictures named "planes", and give each tool a name. Turn the pictures and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide,

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-58

1. For this package the student will need:

   (A) Three pieces of cardboard. (8" x 6")

   (B) A picture of the following tools. (5" x 7")

      1. Block plane

      2. Bench plane

      3. Jack plane

   (C) Folder with the following word on the front.

      1. Planes (large letters)

2. Explanation:

Pictures should be attached to cardboard with the name of each tool on the back of the cardboard. The entire card should be laminated and placed in the folder.

FOR THE STUDENT No I-59

HAND TOOLS AND SIMPLE MACHINES

CUTTING WITH A PLANE

Objective:

Given a plane and a piece of lumber sawed to rough dimensions, you will plane the wood to finish dimensions ($\pm \frac{1}{16}$).

Activity:

1. If you think you can use the plane. get some scrap wood and demonstrate to the teacher or teacher aide your ability to plane to finished dimensions.
    - (A) If you are successful you are done.
    - (B) If unsuccessful, go to number two.
2. Take the 8mm projecter and review the film loop, "Using A Jack Plane."
3. Repeat until you are sure you can plane to a finished dimension.
4. Perform number one.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-59

1. Film loop "Using a Jack Plane" can be purchased:

Eothen Films Limited
70 Furzeaill Road
Boreham wood, Herts, England

FOR THE STUDENT

No. I-61

HAND TOOLS AND SIMPLE MACHINES

FINISHING IDENTIFICATION

Objective:

Given pictures of a spray booth, spray gun, spray bomb, emery cloth, sandpaper, steel wool and paint brushes, you will name each tool for your teacher or teacher aide.

Activity:

1. Take the set of pictures named "finishing", and give each tool a name. Turn the pictures over and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide.

FOR THE STUDENT

No. I-61

HAND TOOLS AND SIMPLE MACHINES

FINISHING IDENTIFICATION

Objective:

Given pictures of a spray booth, spray gun, spray bomb, emery cloth, sandpaper, steel wool and paint brushes, you will name each tool for your teacher or teacher aide.

Activity:

1. Take the set of pictures named "finishing", and give each tool a name. Turn the pictures over and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide.

HAND TOOLS AND SIMPLE MACHINES

PREPARING SURFACES

Objective:

Given abrasive paper and steel wool you will prepare a surface for finishing.

Activity:

1. Using abrasive paper and steel wool you will demonstrate to the teacher or teacher aide the skills needed in preparing the surface.
    - (A) If successful you are done.
    - (B) If unsuccessful, go to number two.
2. Take the 8mm projector and review the following film loops:
    1. "Abrasive papers"
    2. "How to use Abrasive Papers"
    3. "Steel Wool in Woodworking"
3. Practice skills shown in presentation.
    - A. Perform number one.
    - B. Repeat two and three until you are able to successfully prepare the surface.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-62

1. Film loop can be purchased:

The Walden Film Corporation
39 East 31st Street
New York, New York 10019

FOR THE STUDENT No. I-63

HAND TOOLS AND SIMPLE MACHINES

PAINTING

Objective:

Given paint, paint brushes, thinner, stick and rags, you will apply paint to surface that is prepared.

Activity:

1. You will demonstrate to teacher or teacher aide the skills needed to apply paint to prepared surface.
   (A) If successful you are done.
   (B) if unsuccessful, go to number two.
2. Take the 8mm projector and review the following film loops:
   1. "Getting Ready to Paint What You Have Made"
   2. "Handling Paint Neatly"
   3. "Cleaning Up After Painting"
3. Practice skills shown in presentation.
   (A) Perform number one.
   (B) Repeat two and three untill you are able to successfully prepare the surface.

TEACHER RERERENCE INFORMATION FOR STUDENT PACKAGE No. I-63

1. Film loop can be purchased:

The Walden Film Corporation
39 East 31st Street
New York, New York 10019

FOR THE STUDENT

No. I-64

HAND TOOLS AND SIMPLE MACHINES

FINISHING

Objective:

Given the following finishing materials; spray booth, spray bomb, emery cloth, sandpaper, paint brushes, linseed oil, spray gun and steel wool, you will apply finish to prepared surface.

Activity:

1. Take the 8mm projector and review each of the following film loops.
    1. Stains
    2. Shellac
    3. Varnish
    4. Lacquer
    5. Wax and Oil
2. You will demonstrate to the teacher the skills shown in presentation.
    - (A) If successful you are done.
    - (B) If unsuccessful, repeat number one, until you can apply what you have seen.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-64

1. Film loop can be purchased:

McGraw-hill Book Company
330 West 42nd Street
New York, New york 10036

FOR THE STUDENT

No. I-67

HAND TOOLS AND SIMPLE MACHINES

JOINING TWO PIECES OF METAL TOGETHER BY HAND RIVETING

Objective:

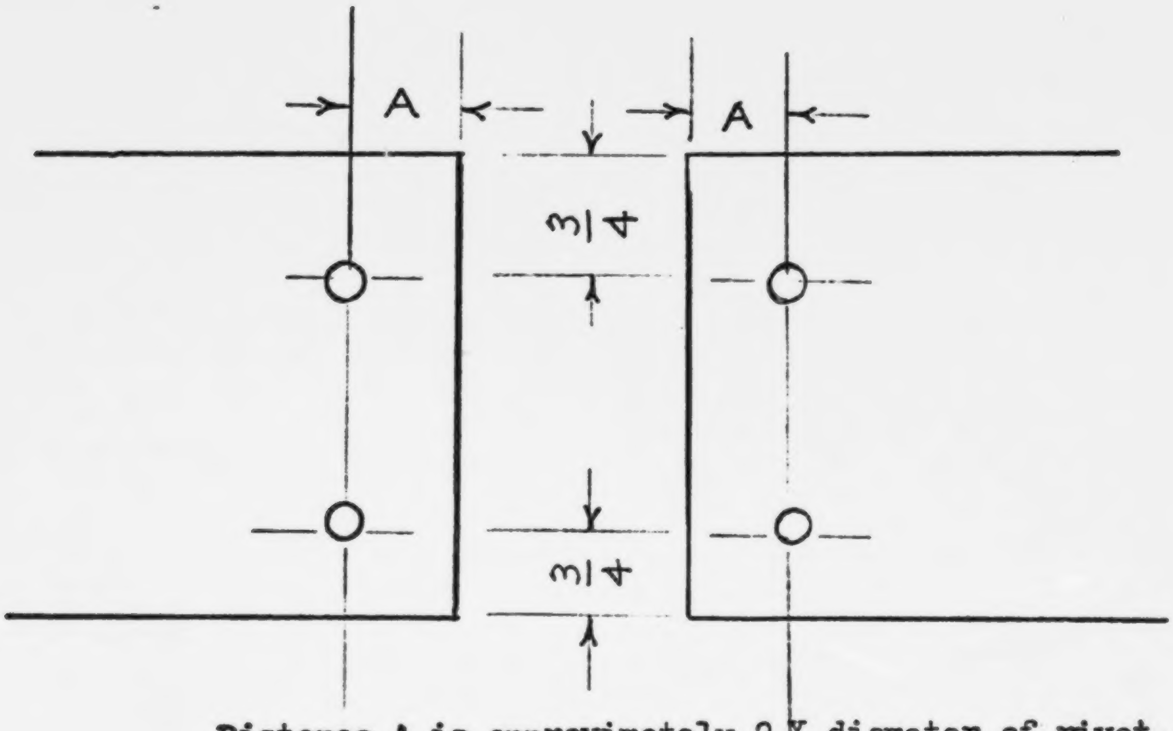
1. Given two 2" x 2" pieces of 26 ga. sheetmetal and two 1/8" soft-iron rivets, you will secure the two pieces of metal together properly by riveting.

Prerequisitie Skills:

1. You must be able to select drills and use the drill press.

Activity:

1. View the film strip, "Rivets and Riveting".
2. Lay out and drill holes for the rivets. See drawing below.
3. Insert the rivets in the holes and set rivets with the rivet set.
4. Begin to round off the shank. Strike it with a riveting or a ball peen hammer until the shank expands and covers and hole slightly.
5. Now form a head on the rivets by placing the cup shaped opening of the rivet set over the shank and strike the set two or three times.
6. Check the riveting. Is the head unmarred? Are the two pieces of metal firmly fastened together?



Distance A is approximately 2 X diameter of rivet.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-67

HAND TOOLS AND SIMPLE MACHINES

JOINING TWO PIECES OF METAL TOGETHER BY HAND RIVETING

1. For this package the student will need;

   A. Tools - scriber, steel rule, combination square, rivet set, 1/8" drill.
   B. Two pieces of 2" x 2" 26 ga. sheetmetal.
   C. 1/8" soft-iron rivets.

2. Concomitant media:

   A film strip "Rivets and Riveting". This film strip is in black and white and consists of 78 frames. It shows the tool, equipment, procedures and methods used in bench riveting. Cost is $4.95.

   Film strip can be purchased from:

   JAM HANDY SCHOOL SERVICE
   2781 E. Grand Blvd.
   Detroit, Michigan 48211

HAND TOOLS AND SIMPLE MACHINES

FASTENING SHEET METAL USING A "POP" RIVETER

Objective:

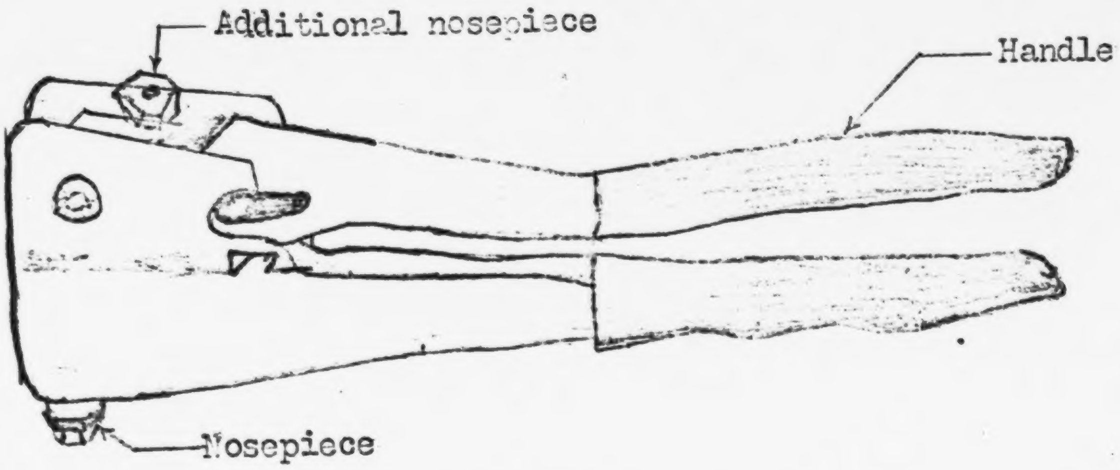
Given a "pop" riveter, 2 pieces of 26 ga. sheet metal 2" x 3", 2 pieces of 16 ga. sheet metal 2" x 3", two 1/8" "pop" rivets, and two 3/16" threaded "pop" rivets, you will be able to:

A. Change and set up nosepieces in the rivetool.
B. Fasten two pieces of 26 ga. sheet metal together using 1/8" steel "pop" rivets.
C. Set two threaded "pop" rivets in a piece of 16 ga. sheet metal and fasten it to a piece of sheet metal with two 10-24 machine screws.

Introduction:

Whether it's shop projects or home repairs, "pop" rivets can be used in place of many types of ordinary fastenings and they will do the job faster, easier and better.

This riveter will set threaded "pop" rivets, 1/8" and 3/16" diameter "pop" rivets. Before you use the riveter look over its features. See Fig. 1.



Activity:

1. Layout and center punch the four pieces of metal for drilling. Drill the two 26 ga. pieces for a 1/8" "pop" rivet with a 1/8" or No. 30 drill. Drill the two 16 ga. pieces for threaded "pop" rivets with a 1/4" drill. See Fig. 2.

2. Check and see that the nosepiece for 1/8" "pop" rivets is placed in the nosepiece of the riveter. Now fully open the handle of the riveter and place the stem of the 1/8" "pop" rivet in the nosepiece of the tool. See Fig. 3.

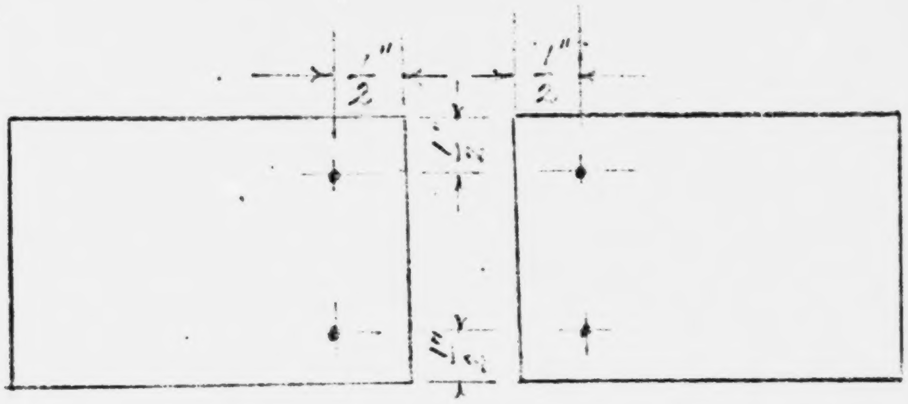


Fig. 2. Lay out drawing of four pieces.

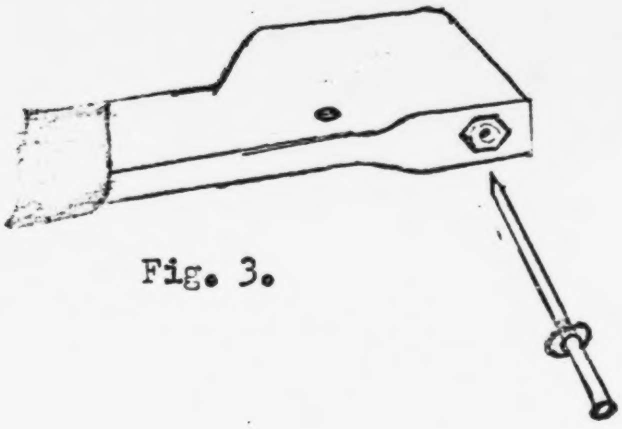


Fig. 3.

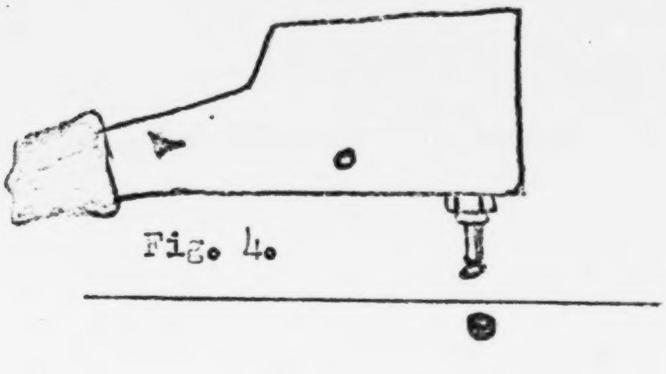


Fig. 4.

3. Insert rivet in hole of work to be fastened. Be sure you have the pieces with 1/8" holes drilled in them. See Fig. 4.

4. Now squeeze tool handles till you feel stem break. If stem does not break on first pull, open handles fully, move up on stem, and squeeze again.

5. You have now "pop" riveted one of the holes in your work piece. Repeated steps 3 and 4 to fasten the other hole with a rivet.

6. To set threaded "pop" rivets into the piece of 16 ga. metal, first screw the rivet on to the stem. See Fig. 5.

7. The 3/16" nosepiece is needed for this operation. Change nosepieces.

8. Place the stem into the riveter, and insert in 1/4" hole.

9. Squeeze handle of tool to set rivet. Handle of tool should not be squeezed more than once or difficulty may be encountered unscrewing reusable stem.

10. Repeat steps 8 and 9 to set threaded "pop" rivet into other 1/4" hole.

11. Now that the two threaded rivets are set into the one piece, fasten the two pieces together with two 10-24 machine screws. Tighten the screws with a 1/4" screwdriver.

12. You are now finished. Take your work over to your teacher for checking.

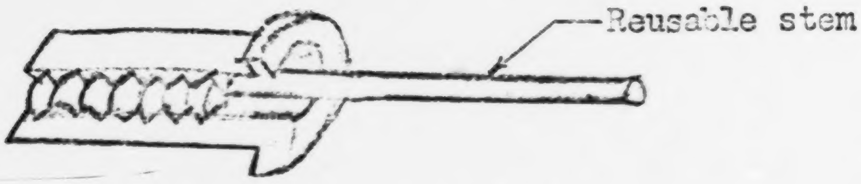


Fig. 5. Threaded "pop" rivet.

FOR THE STUDENT No. I-80

HAND TOOLS AND SIMPLE MACHINES

POSITIONING WORK FOR THE BAND SAW

Objective:

You will position work for cutting, using the band saw.

Activity:

1. Using a band saw, position the work for cutting; teacher or teacher aide will check position.

   (A) If successful you are done.

   (B) If unsuccessful, go to number two.

2. Take the 8mm projector and review the film loop, "Cutting Shapes With A Band Saw"

3. Practive positioning work as shown in presentation.

   A. Perform number one.
   B. Repeat two and three until you are to successfully position work.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-80

1. Film Loop can be purchased:

Film Associates
11559 Santa Monica Blvd.
Los Angeles, California 90025

FOR THE STUDENT No. I-81

HAND TOOLS AND SIMPLE MACHINES

POSITIONING WORK FOR THE CIRCULAR SAW

Objective:

You will position work for cutting, using the circular saw.

Activity:

1. Using a circular saw, position the work for cutting; The teacher or teacher aide will check position.
   - (A) If successful you are done.
   - (B) If unsuccessful, go on to number two.
2. Take the 8mm projector and review the film loop "Cutting Stock to Length Using a Circular Saw."
3. Practice positioning work as shown in presentation.
   1. Perform number one.
   2. Repeat two and three until you are able to successfully position work.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-81

1. Film loop can be purchased:

Film Associates
11559 Santa Monica Blvd.
Los Angeses, California 90025

FOR THE STUDENT

No. I 85

HAND TOOLS AND SIMPLE MACHINES

USING A DIE TO THREAD A ROD OR PIPE

Objective:

Given a 4" long, ¼" diameter rod, cutting oil, and a ¼-20 die, you will thread 1½" along the rod.

Activity:

1. View the film strip "Cutting Threads with Taps and Dies".
2. Mount the rod upright in a bench vise, and file a slight bevel on the end of the rod for easier starting. See Fig. A.
3. Select the correct die and insert it in the die stock.
4. Place the die, with the beveled end down, over the rod and apply some cutting oil. See Fig. B.
5. Grasp the die stock with both hands near the die, press down firmly upon the work, and at the same time slowly screw it on the work in a clockwise direction.

   Be sure the die goes on squarely. You can check for squareness by using a solid steel square.
6. After the thread is started, turn the die forward one revolution and then back one quarter turn in order to break and clean away the chips. Continue to apply cutting oil.
7. Cut threads until you have 1½" in length.
8. When finished, clean the threads and check with a nut or thread gage. If the threads binds, close the die slightly by turning the set screw. Recut the thread.
9. When completed, take work to the instructor for checking.

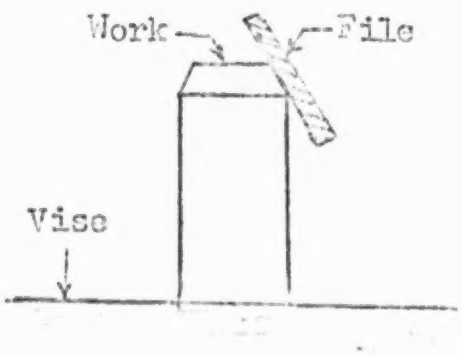


Fig. A Beveling end of work.

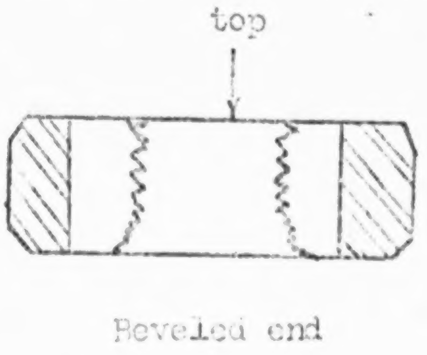


Fig. B Bevel on threading die.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I 85

1. For this package the student will need:

   A. 1 - 4" long, ¼" diameter rod.
   B. A ¼-20 round adjustable split die
   C. A die stock.
   D. A File.
   E. Can of cutting oil.
   F. A ¼" screwdriver.

2. Concomitant Media:

   A film strip "Cutting Threads with Taps and Dies". This film strip is in black and white and consists of 48 frames. It shows how to use a hand die to cut threads on a stud to fit in a tapped hole. The film strip can be borrowed or rented from local or state film libraries listed by the U.S. Office of Education, Washington, D.C. 20225.

   A film loop, "Cutting External Threads", No. 67-1293, is available from McGraw-Hill Films, 330 West 42nd Street, New York, New York 10036. Cost is $20.00. Length 4 minutes.

FOR THE STUDENT

HAND TOOLS AND SIMPLE MACHINES

MAKING INTERNAL THREADS WITH A HAND TAP

Objective:

1. Given a piece of ½" x 2" x 2" metal and a 3/8-16 tap, you will drill the proper hole size in the metal and thread the hole with the tap.

Prerequisite Skills:

1. You must be able to select drills and use the drill press.
2. You must be able to read the use a "Tap and Drill Sizes" wall chart.

Activity:

1. View the film strip "Tapping and Threading".
2. Lay out and drill a hole in the center of the piece of metal.
3. Determine the proper drill size for a 3/8-16 tap by consulting the wall chart.
4. Mount the work in a drill vise and drill the hole.
5. Select a tap wrench and tighten the tap in the wrench.
6. Begin the tapping procedure. Be sure to apply lubricant.
7. When the hole is completely threaded, clean the chips from the hole and check the threads with a 3/8-16 bolt or a thread plug gage.
8. Are the threads correct? If so, turn your work in to the instructor.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-87

1. For this package the student will need:

   A. A piece of ½ x 2" x 2" metal.
   B. A 3/8-16 tapered tap.
   C. A tap wrench.
   D. Lubricant.
   E. A Tap drill.
   F. A steel square or try square.

2. Concomitant media;

   A. A film strip "Tapping and Threading". This film strip is in black and white and consists of 72 frames. It shows the procedures and methods for tapping holes. Cost is $4.95.

   Film strip can be purchased from:

   JAM HANDY SCHOOL SERVICES
   2781 E. Grand Blvd.
   Detroit, Michigan 48211

   B. Another film strip "Cutting Threads with Taps and Dies" is available. It consists of 48 frames and may be borrowed or rented from local or state film libraries listed by the U.S. Office of Education, Washington 25, D.C.

HAND TOOLS AND SIMPLE MACHINES

REMOVING A BROKEN BOLT FROM A HOLE WITH A SCREW EXTRACTOR

Objective:

To remove a broken bolt from a hole with the proper screw extractor.

Activity:

1. Look at the "Screw Extractor and Drill Selection Table on the next page." Determine which drill and extractor is needed for your job.
2. Drill down into the top and center of the broken bolt.
3. Put the correct size screw extractor in the hole.
4. Mount and tighten a tap wrench on the extractor and then turn it to the left (counterclockwise) until the bolt backs out. See Fig. 1.

   The screw extractor acts like a corkscrew. It grips into the sides of the hole and when the right force is used the belt begins to turn and come out.

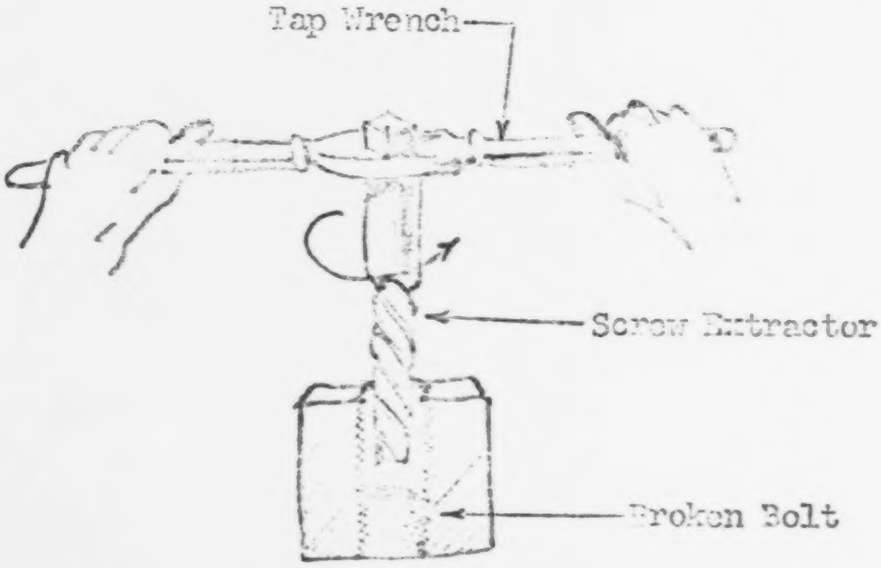


Fig. 1

SCREW EXTRACTOR AND DRILL SELECTION TABLE

No. I 88

Number of Extractor	For Screws and Bolts		Size Drill to use
	Machine Screw Size	Fractional Sizes	
1	4 to 10	1/8 to 3/16	5/64
2	12 to 14	3/16 to 5/16	7/64
3	-	5/16 to 5/16	5/32
4	-	7/16 to 9/16	1/4
5	-	9/16 to 3/4	17/64
6	-	3/4 to 1	13/32
7	-	1 to 1 3/8	17/32
8	-	1 3/8 to 1 3/4	13/16

HAND TOOLS AND SIMPLE MACHINES

REMOVE A BROKEN TAP WITH A TAP EXTRACTOR

Objective:

If a tap should break off in a hole, you will be able to remove the tap using a tap extractor.

Activity:

1. Place your work firmly but carefully in a vise.
2. Be sure to clean out all the loose broken chips.
3. Force the wire jaws down into the flutes of the tap so that they grip it firmly. See Fig. 1.
4. Push the re-enforcing collar down over the jaws as close to the work or tap as possible.
5. Place a tap wrench on the squared end of the extractor.
6. Now gently but firmly work the extractor back and forth to loosen the tap. When the tap is loosened, turn the extractor counter-clockwise to remove it.
   Do not force the extractor too hard, otherwise the jaws might twist, bend, or break off.
7. Give the broken tap to your teacher.

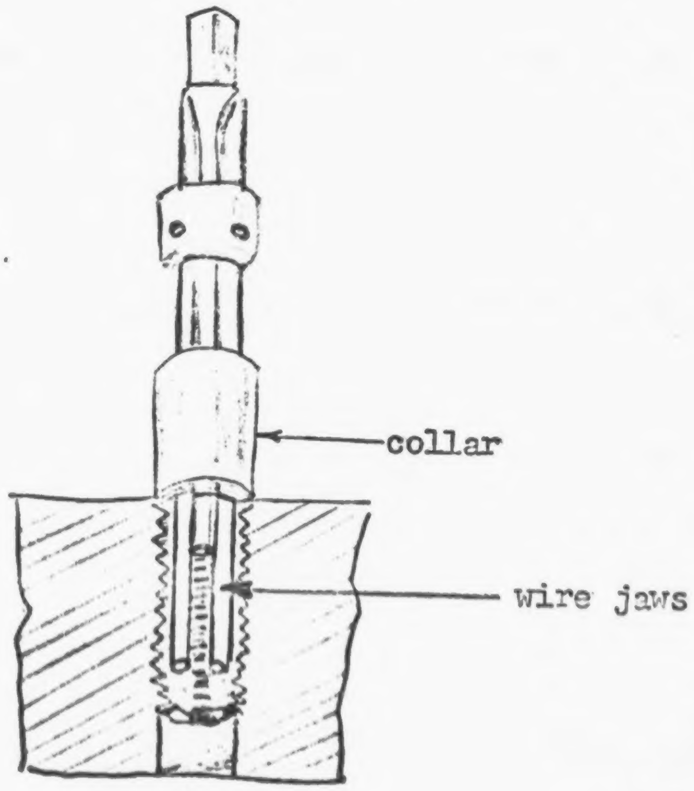


Fig. 1 Tap extractor and application.

FOR THE STUDENT

HAND TOOLS AND SIMPLE MACHINES

SHEET METAL HAND SNIPS IDENTIFICATION

Objective:

Upon completion of this package, you will be able to identify the three most commonly used hand snips for sheet metal, and state the use of each one.

Introduction:

Hand snips are a good deal like scissors, except that they are made stronger and heavier for cutting sheet metal (22 gauge or thinner). This package will introduce you to the three common types of hand snips. These snips are made in various sizes, based on the length of the cutting blade, usually from 2 to 4 inches in length. Figs. 1A - 1C show the common hand snips.

Activity:

1. Look at the hand snips in Fig. 1. They are:
    - A. Straight snips - used for cutting straight lines and outside curves.
    - B. Hawks-bill snips - used for cutting inside openings or curves.
    - C. Aviation snips - used for making straight or irregular cuts. These are made in three styles: the left, which cuts to the left; the right, which cuts to the right; and the universal, which cuts either right or left.
2. Now go to the tool panel and pick one of each of these three hand snips. Do you have the correct ones: Check yourself by looking at Fiug. 1.
3. Take the post test. First, name the type of hand snip, and then indicate the cutting operation for which it is used.
4. When finished with the test, give it to your teacher for checking.

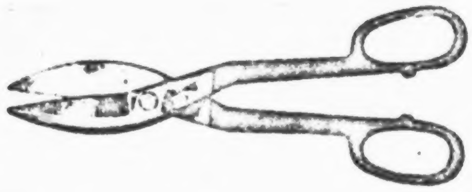


Fig. 1A Straight snips

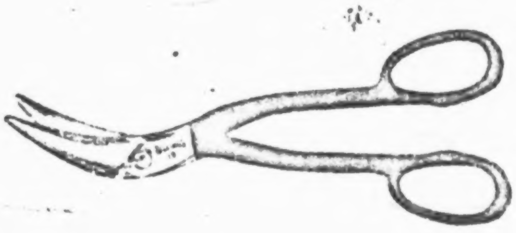
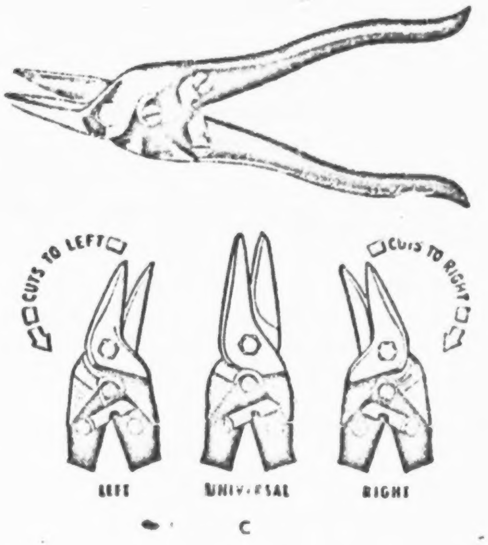


Fig. 1B Hawks-bill snips

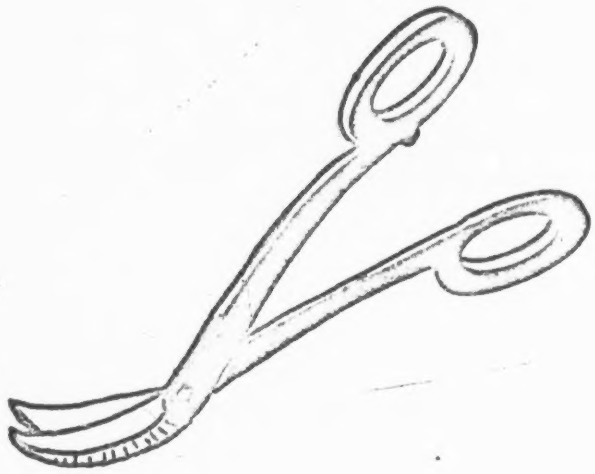


CUTS TO LEFT
CUTS TO RIGHT
LEFT
UNIVERSAL
RIGHT
C

Fig. 1C Aviation snips

POST TEST

Directions: Name the types of hand snips below by filling in the blanks.



A. ____________________

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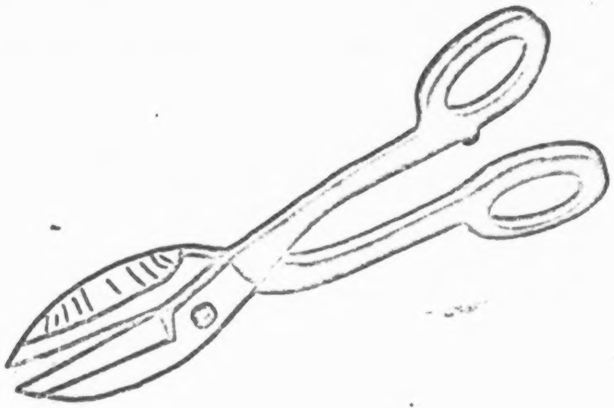

B. ____________________

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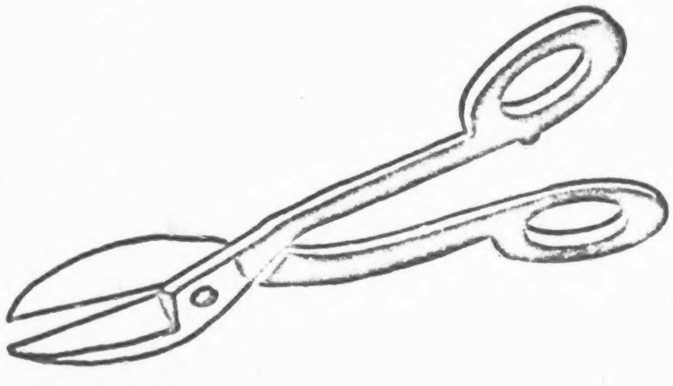

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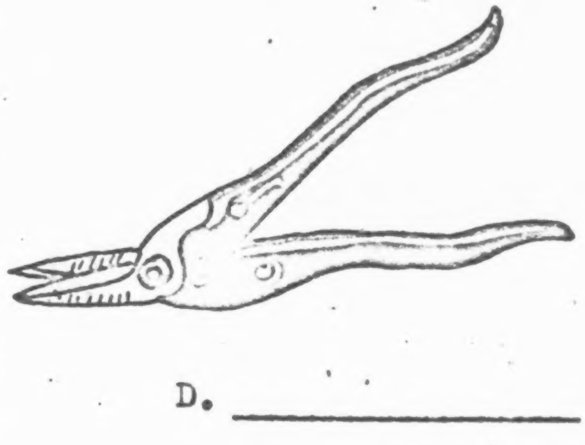

D. ____________________

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HAND TOOLS AND SIMPLE MACHINES

CUTTING SHEET METAL WITH HAND SNIPS

Objective:

1. Given four pieces of 4" x 4" 26 ga. sheet metal, a pair of straight snips, aviation snips, and hawks-bill snips, you will:
    - A. Cut straight lines using the straight snips.
    - B. Cut an outside curve using the aviation snips.
    - C. Cut an inside curve using the hawks-bill snips.
    - D. Cut notches using the straight snips.

Prerequisite:

Complete package No. I 93, Sheet Metal Hand Snips Identification.

Activity:

1. View the film strip, "Laying Out and Cutting Sheet Metal".

Making Straight Cuts

2. Lay out and scribe two straight lines (Fig. 1) on a piece of 4" x 4" sheet metal.
3. Select the straight snips. Hold the smallest part of the piece of sheet metal in your left hand and the snips in your right hand.
4. Open the snips as far as possible, and insert the metal. Hold the straight side of the blade at right angles to the sheet. Now squeeze the handle firmly, and cut to about ¼ to ½ inch from the point of the blade. Reopen the snips and complete.

Cutting Outside Curves

5. Use a pair of dividers and scribe a 3" diameter circle on a piece of 4" x 4" sheet metal.
6. Select a pair of aviation snips.
7. Hold the metal in your left hand, and rough-cut to within 1/8 to ½ inch of the lay out line.
8. Carefully cut up to the layout line and around it, making a continuous cut.

Making Inside Cuts

9. Take a piece of 4" x 4" sheet metal and draw a curve like the one in Fig. 3.
10. Select a pair of hawks-bill snip. Hold the metal in your left hand and the snips in your right. Begin cutting at the edge of the metal an inside curve. Be sure you stay inside of the scribed circle. See Fig. 3.

Notching

11. When cutting a notch or a corner, use only the end of the blade of a pair of straight snips.
12. Layout and scribe a straight line on a piece of 4" x 4" sheet metal. See Fig. 2.
13. Open the snips only part way, and use only the portion near the point of the blade for the cutting. Cut several notches in the metal. Be careful and do not cut past the layout line.

Post test

14. When completed, take your pieces of metal to the teacher aide or teacher for inspection.

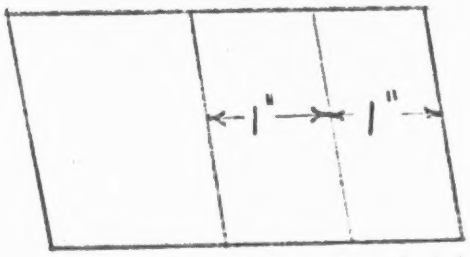


Fig. 1 Make straight cuts along layout lines with straight snips.

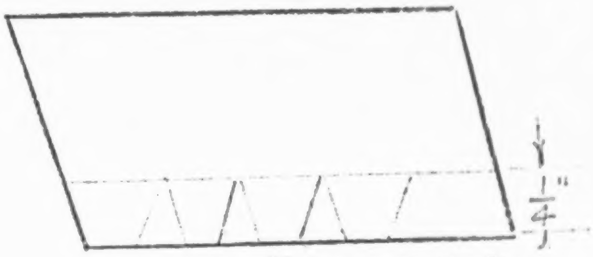
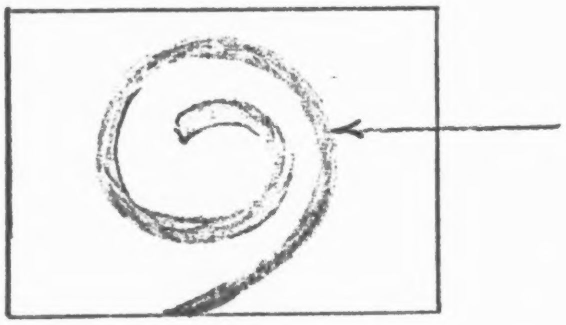


Fig. 2 Make notched cuts with straight snips along layout lines.



Material to be removed.

Fig. 3 Cut an inside curve using the hawks-bill snips. Stay inside of the scribed circle.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I 94

HAND TOOLS AND SIMPLE MACHINES

CUTTING SHEET METAL WITH HAND SNIPS

1. For this package the student will need:

   A. Four 4" x 4" pieces of 26 ga. sheet metal.
   B. Hand Snips - Aviation type, straight type, and Hawks-bill type.
   C. Layout tools - scriber, dividers, and stell rule.

Media

A film strip "Laying Out and Cutting Sheet Metal". This film strip is available in black and white only. Its length is 44 frames. The film strip gives clear, simple captions and close-up photography with step-by-step instruction in the correct techniques of cutting with hand snips.

Film strip can be purchased from:

McGraw-Hill Films
330 West 42nd Street
New York, New York 10036

Cost of film strip is $6.00.

FOR THE STUDENT

No. I 100

HAND TOOLS AND SIMPLE MACHINES

BENDING SHEETMETAL USING THE BAR FOLDER

Objective:

1. Given a piece of sheetmetal and a bar folder, you will adjust the bar folder to a specified depth, ± 1/16".

Prerequisite Skills:

1. You must be able to read correctly the 1/16 and 1/8 scale on the steel rule.

Activity:

1. Answer the questions on page 2 of this package. When you are finished, give it to your teacher.
2. View the film strip, "How to Operate a Bar Folder".
3. Go to the bar folder and proceed to adjust it for a bend with a depth of 1/4".
4. Now check the depth, and make a full bend (single hem) on a piece of exercise sheetmetal.
5. Check this bend using a steel rule, and, if properly made, hand in to the instructor for checking.
6. Using the three exercise pieces issued to you, adjust for width of fold on the depth gage and make single hems of 5/16", 1/2", and 9/16".

FOR THE STUDENT

No. I-233

HAND TOOLS - SIMPLE MACHINES

JOINING: SOLDERING ONE PIECE OF METAL TO ANOTHER

Objective:

Given two pieces of 22 gauge tin plate, 2 inches wide and 6 inches long, an asbestos tile, a bar of 50-50 solder, a small paint brush, a jar of flux (liquid), a 4 inch square piece of medium emery cloth, and a hot tinned electricsoldering copper, you will sweat solder a ½ inch wide lap joint along the length of the two pieces of tin plate so that they will not come apart from one another when bent.

Pretest:

Given the necessary tools and materials, sweat solder a ½ inch wide lap seam along the lengths of the two metal pieces so that the two pieces of metal will not come apart from one another when bent.

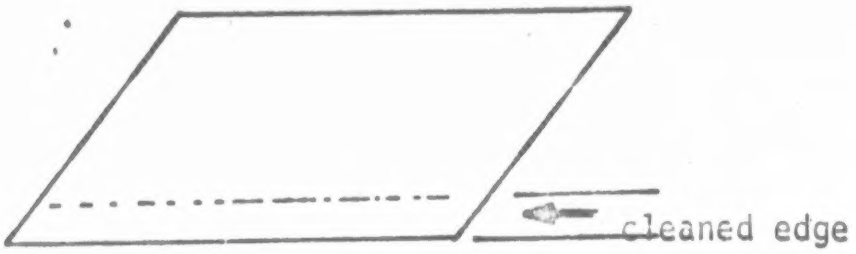
Activity:

With the help of the teacher assistant, assemble the tools and materials listed below. Then, read the step by step directions below, making sure to look at the pictures. After you have read all of the directions, repeat all the steps with the tools and materials needed to do the task until you can do it correctly.

Materials:

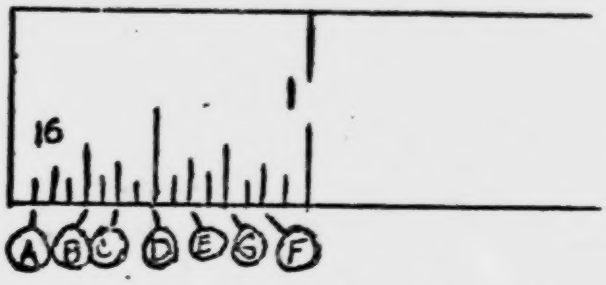
2 pieces of 22 gauge tin plate, 2" wide, 6" long
1 small paint brush
1 can of flux (liquid)
1 bar, 50-50 solder
1 asbestos tile
1 piece of emery cloth, 4 " square, medium grit
1 hot electric solder copper (USE CAUTION WHEN HANDLING)

Clean a ½ inch wide area the length of each piece of metal on only one side of each piece by rubbing it with the rough side of the emery cloth.



PRE-TEST

1. Can you correctly read a rule? Read the drawing below of a rule and fill in the blanks.


16
1
A
B
C
D
E
G
F

A. ____________________

B. ____________________

C. ____________________

D. ____________________

E. ____________________

F. ____________________

G. ____________________

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I 100

1. For this package the student will need;

   A. An attached sheet containing the pre-test.
   B. A steel rule.
   C. Three pieces of 2" X 3" 26 ga. sheetmetal.

2. Concomitant Media:

   A film strip "How to Operate a Bar Folder". Film strip consists of 22 frames. That part of the film devoted to adjusting the bar folder to a specified depth, adequately shows the content desired.

   Film strip can be purchased from the Milwaukee Public Museum Audio Visual Department, No. 8537.

HAND TOOLS AND SIMPLE MACHINES

SHEET METAL STAKES

OBJECTIVE:

Upon completion of this package, you will be able to identify the six commonly used sheet metal stakes, and state how they are used to form and bend sheet metal.

INTRODUCTION:

Sheet metal can be formed and bent in many ways. one of the ways to form or bend sheet metal is by using metal stakes. Metal stakes are made in many sizes and shapes. This package will introduce you to the most commonly used ones.

The transparency included in this package will show you the six stakes. These stakes fit in a stake holder, shown in Fig. 1. Note the interesting names for these various stakes.

The film strip included in this package will explain the use of the various stakes.

ACTIVITY:

1. View the sheet metal stake identification transparency. Notice the names and characteristics of the stakes.
2. Turn off the projector and go over to the sheet metal bench. Pick out the stakes you have just viewed. Can you name them? If not, go back to the projector and study the transparency again.
3. Now view the film strip, "Sheet Metal Forming".
4. When finished viewing the film strip, take the post test. Fill in the blank lines with the correct name of the stakes.
5. Check your answers and then give the test to your teacher for checking.

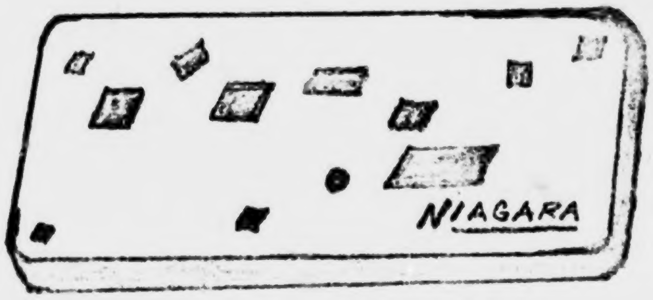


Fig. 1 A stake-holder plate.

TEACHER REFERENCE AND INFORMATION FOR STUDENT PACKAGE No. I 101

1. For this package the student will need:

   A. A transparency showing the six sheet metal stakes.
   B. A film strip, "Sheet Metal Forming".

2. Concomitant media:

   A. A transparency, "Sheet Metal Stakes Identification". This transparency should be made from the sheet with the drawings of the six stakes included in this package.

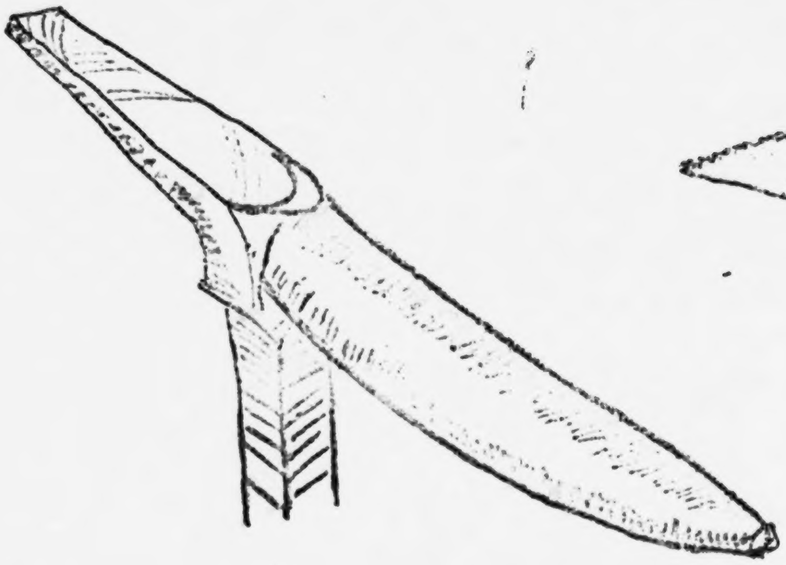
   B. A film strip, "Sheet Metal Forming". This film strip is in black and white and consists of 45 frames. The film strip demonstrates the various uses of metal stakes. Its cost is $6.00.

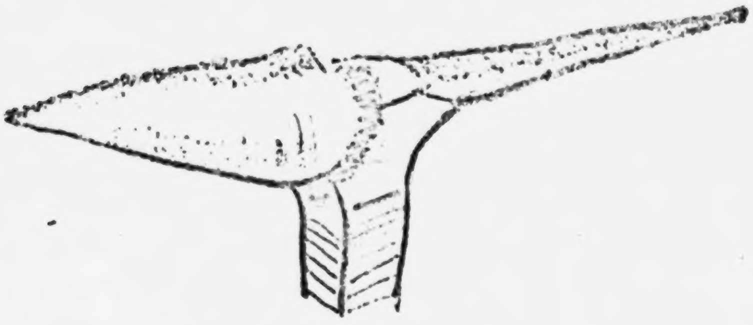
   The film strip can be purchased from;

   McGraw-Hill Films
   330 West 42nd Street
   New York, New York 10036

SHEET METAL STAKES IDENTIFICATION

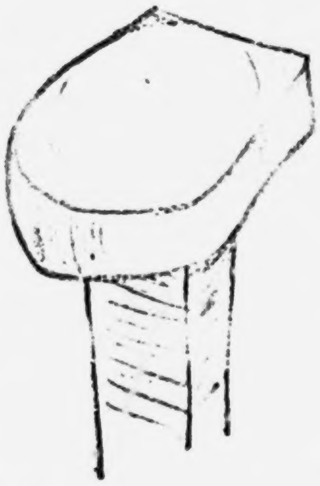
POST TEST

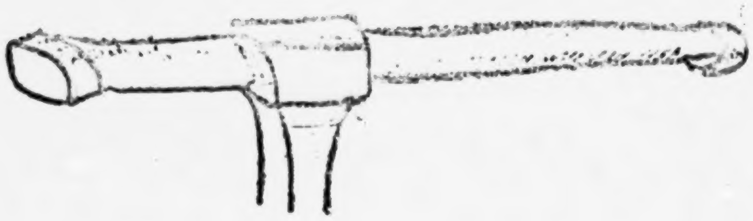




B. ______________________________

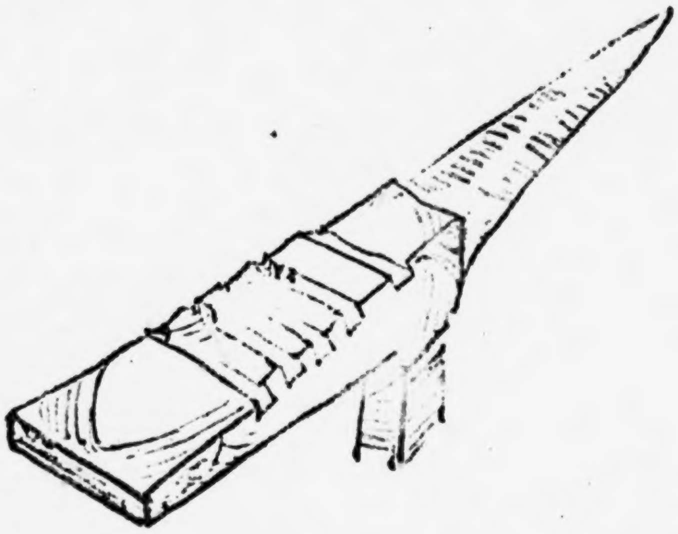
A. ______________________________

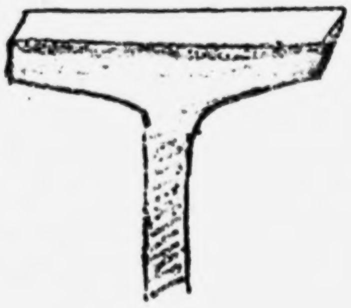




D. ______________________________

C. ______________________________

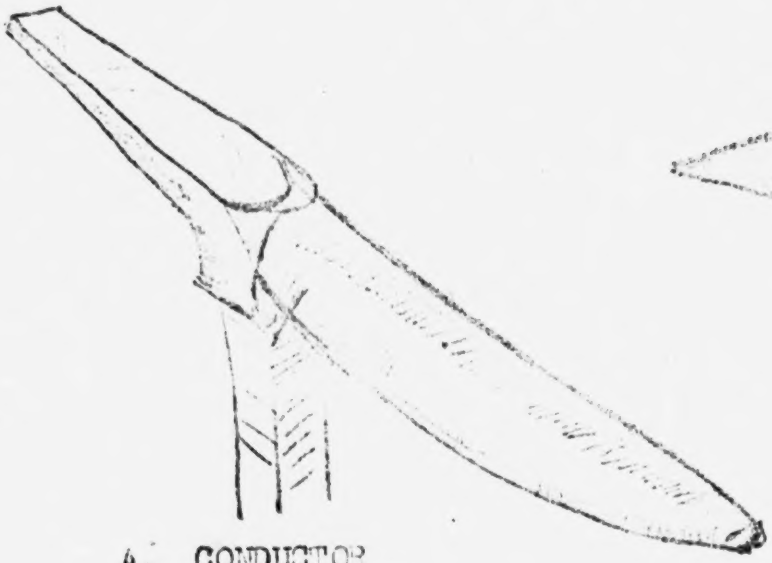




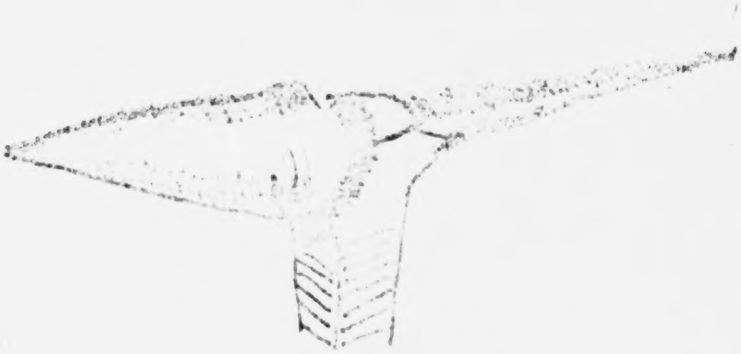
E. ______________________________

F. ______________________________

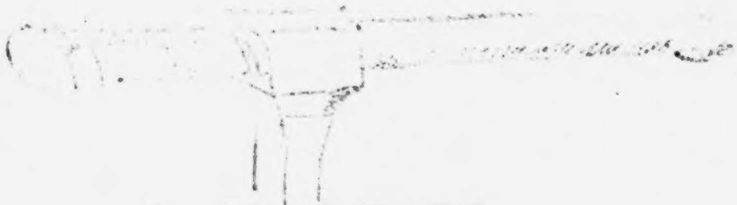
SHEET METAL STAKES IDENTIFICATION



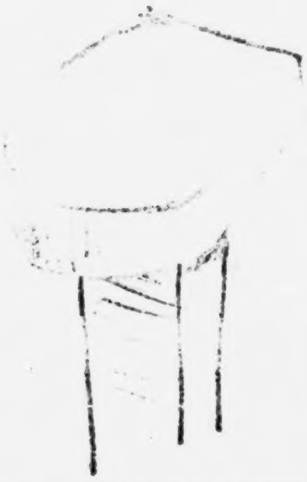
A. CONDUCTOR



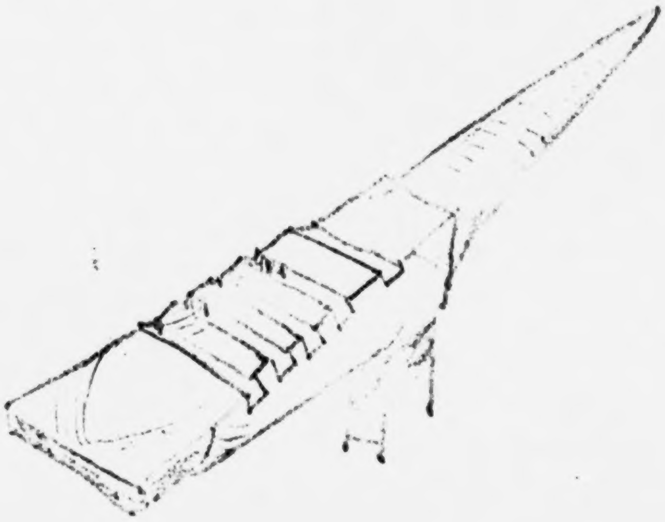
B. BLOWHORN



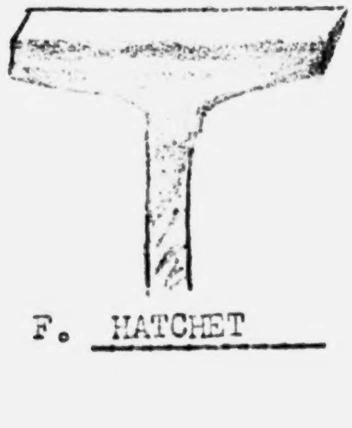
C. DOUBLE-SEAMING



D. COPPERSMITHS SQUARE



E. CREASING WITH HORN



F. HATCHET

FOR THE STUDENT

No. I 102

HAND TOOLS AND SIMPLE MACHINES

BENDING SHEET METAL ON THE BOX AND PAN BRAKE

Objective:

Given a box and pan brake, a bar folder, and a piece of 10½" x 12½" 26 ga. sheet metal with scribed layout lines, you will form a box by:

1. Bending all hems (4) on the bar folder.
2. Bending the sides at 90 degrees on the box and pan brake.

Prerequisite:

You must have successfully completed the following packages:

1. No. I 100 "Bending Sheet Metal Using the Bar Folder".
2. No. I 151 "Making a Simple LAYOUT Using a Combination Square, Steel Rule, and a Scriber".

Introduction:

To bend all four sides of a box, the box and pan brake is very useful, see Fig. 1. The upper jaw is made of various widths of removable fingers. You use only the number of fingers necessary for the length of bend you want.

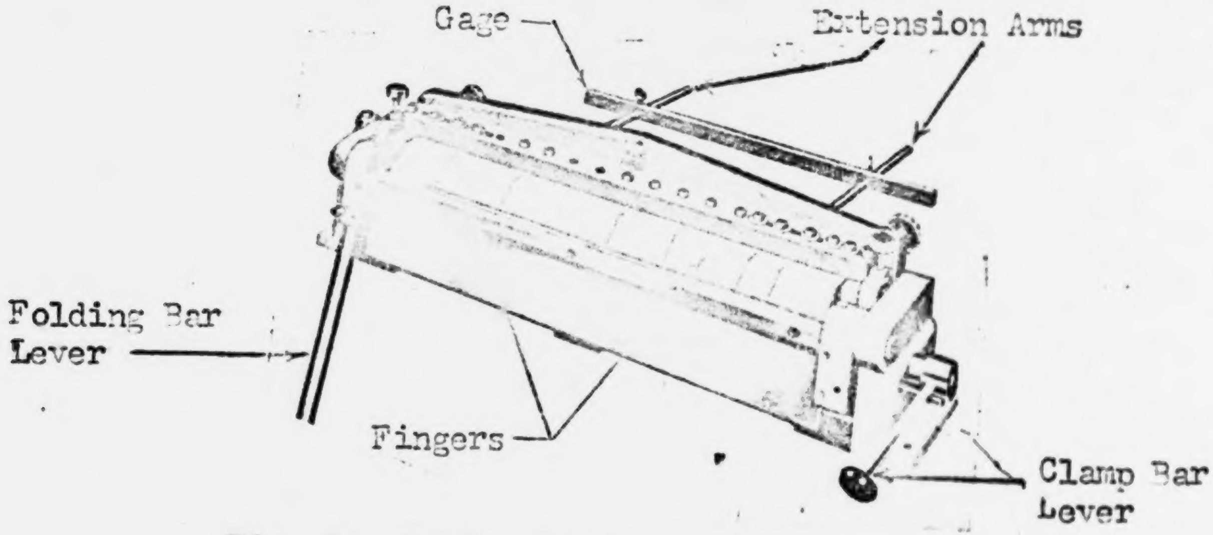


Fig. 1. Parts of a box and pan brake.

Activity:

1. Study the attached drawing of a sheet metal box.
2. Go to the bar folder and bend four single hems (layout lines No's. 1, 2, 3, and 4). Flatten each hem by placing the folder edge up on the bed of the bar folder and pull down the handle with some force.
3. Now go to the box and pan brake with your work.

Bending the Sides

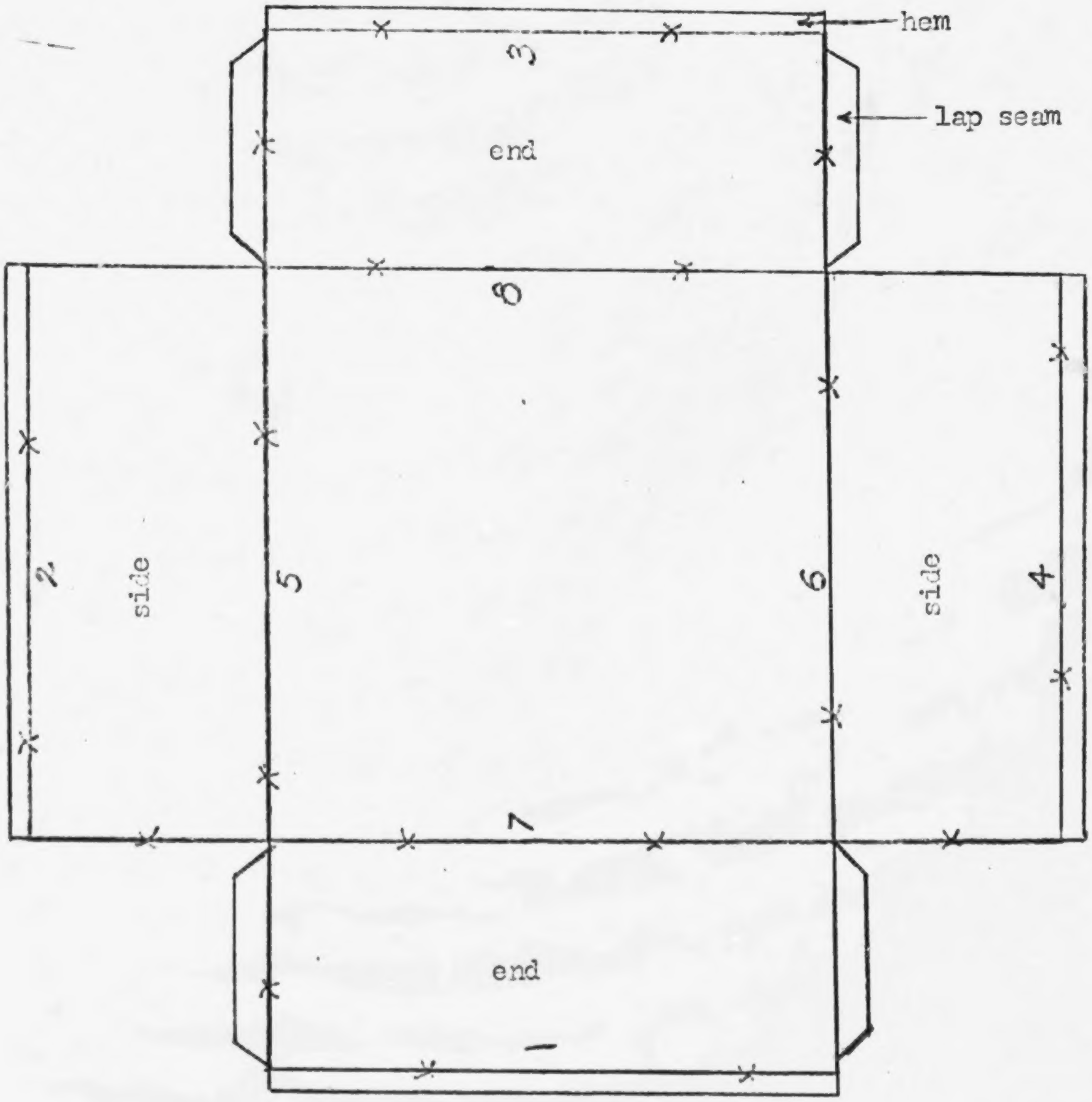
4. Lift the clamp bar lever and insert the metal in the brake. Tighten the bar lever, with layout line no. 5 directly under the front edge of the upper jaw.

   It is a good idea to check on edge of the metal and the front edge of the upper jaw with a square.
5. Now lift up the folding bar lever until you have bent line no. 5 at a 90 degree angle. Go a few degrees past this angle, because the metal tends to spring back.
6. Release the clamp bar lever and remove the metal. Now insert the metal in the brake, tighten the bar lever with line no. 6 directly under the front edge of the upper jaw.
7. Proceed to bend the second side at 90 degrees.

Bending the Ends

8. Fit just enough fingers together to equal the width of the box. Bend the first end up to 90 degrees, keeping the lamp seams on the outside. Be careful and do not over bend or else you will crimp the sides slightly.
9. Reverse the metal and bend the second end.
10. You are now finished. How well did you do? Take your work to the instructor for checking.

SHEET METAL BOX


hem
lap seam
3
end
8
2
side
5
6
side
4
7
end
1

FOR THE STUDENT

No. I 104

HAND TOOLS AND SIMPLE MACHINES

MAKING A GROOVED SEAM WITH A HAND GROOVER

Objective:

Given two pieces of 3" x 3" 26 ga. sheet metal, a bar folder, and a No. 2 hand groover, you will make a 1/4" grooved seam.

Prerequisite:

You should have completed package No. I 100, BENDING SHEET METAL USING THE BAR FOLDER.

Activity:

1. View the film strip, "Sheet Metal Forming and Seaming".
2. Go to the bar folder and set it to make a 1/4" open hem.
3. Make a 1/4" open hem on each piece of sheet metal, as in Fig. 1.
4. Place the metal over a flat solid backing such as a stake or or a metal table. Hook the two open hems together, as in Fig. 2.
5. Take the No. 2 hand groover, hold it over the seam with one edge of the groover over one edge of the seam.
6. Strike the groover solidly with a metal hammer to close one end of the seam. Slide the groover along as you strike it, to complete the seam. A seam that has been grooved will look like Fig. 3.
7. Check the seam after it is locked. Is the seam well-formed and without nicks? Is the seam smooth?
8. Take your finished work to the teacher aide or the teacher for checking.

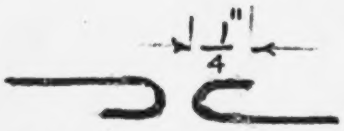


Fig. 1 Open hems

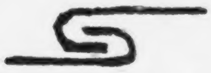


Fig. 2 Hooked hems

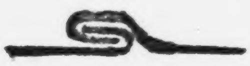


Fig. 3 Grooved seam

TEACHER REFERENCE AND INFORMATION FOR STUDENT PACKAGE No. I 104

1. For this package the student will need:

   A. A No. 2 hand groover
   B. A bar folder
   C. Two pieces of 3" x 3" 26 ga. sheet metal.
   D. A ball peen hammer.
   E. A film strip, "Sheet Metal Forming and Seaming".

2. Media:

   A film strip, "Sheet Metal Forming and Seaming". The film strip is in black and white and consists of 44 frames. It demonstrates the use of the hand groover and explains the reasons for making the various seams.

   The film strip can be purchased at a cost of $6.00 from:

   McGraw-Hill Films
   330 West 42nd Street
   New York, New York 10036

FOR THE STUDENT

No. I 105

BENDING AN EDGE OR FOLDING A HEM USING THE HAND SEAMER

OBJECTIVE:

Given a hand seamer and a piece of 26 ga. 5" X 5" sheet metal, you will;

1. Layout the piece of sheet metal as shown in Fig. 2.
2. Remove four 1" square corners of the layed-out piece using a pair of straight snips.
3. Bend the four 1/4" using the hand seamer.

PREREQUISITE:

You must have successfully completed the following packages; No. I 94 CUTTING SHEET METAL USING HAND SNIPS, and No. I 152 MAKING A SIMPLE LAYOUT.

INTRODUCTION:

Sheet metal can be formed or bent in many ways. The hand seamer, see Fig. 1, is a tool that is used to make sharp-angle bends or to form hems on a small piece of metal. The blade on a hand seamer is adjustable. It will make angled bends or folded hems from 5/16" to 7/8" wide.

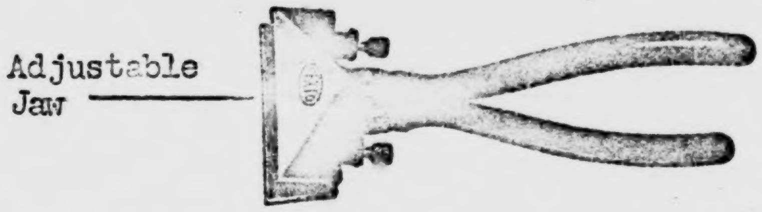


Fig. 1 Hand Seamer

ACTIVITY:

1. Layout workpiece using layout tools as shown in Fig. 2.
2. Remove the four 1" square corners using a pair of straight snips.
3. Adjust the blade of the hand seamer to make a 1/4" bend. Check the adjustment by taking a steel rule and measuring from the edge of the blade to the edge of the back of the hand seamer, see Fig. 1.
4. Grasp the metal and line the edge of the blade on the bend line No. 1.
5. Now turn the edge to a 60 degree angle. Check the angle with a 60 degree triangle or a T-bevel that has been set for 60 degree. See Fig. 3. This procedure is used to bend an angle of any degree desired.
6. Now procede on to make a folded hem out of the 60 degree bend. Place the blade of the hand seamer back on the bend line and bend it as far down as it will go.
7. Open the seamer, place it over the fold, and squeeze the metal

to close the hem.

8. Make closed hems on bend lines 2, 3, and 4. Follow the same procedure used to make the closed hem on bend line No. 1, activity 6 and 7.
9. When finished, give your workpiece to your teacher for checking.

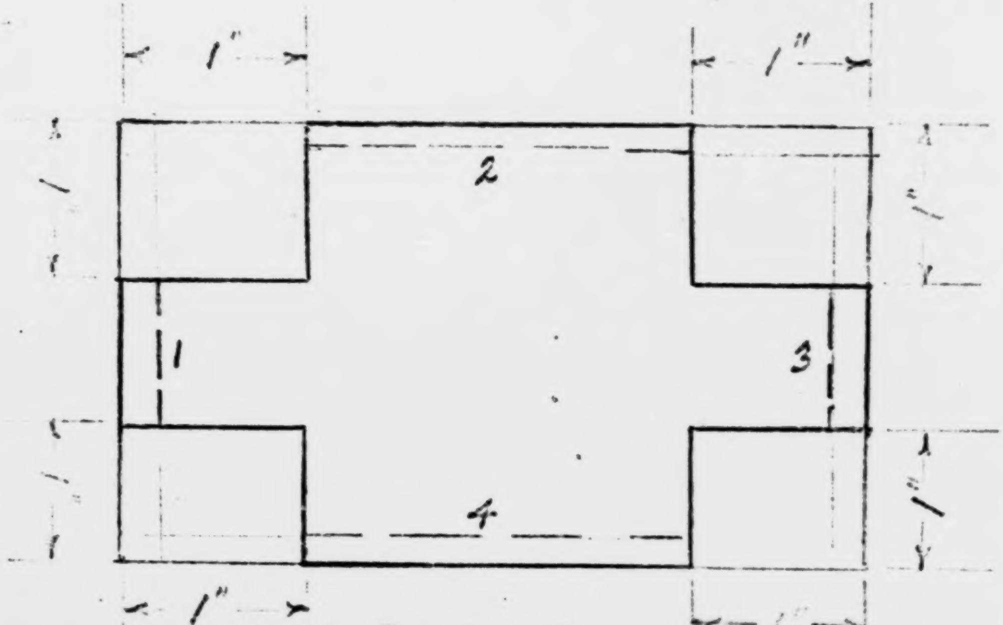


Fig. 2 Drawing of workpiece.

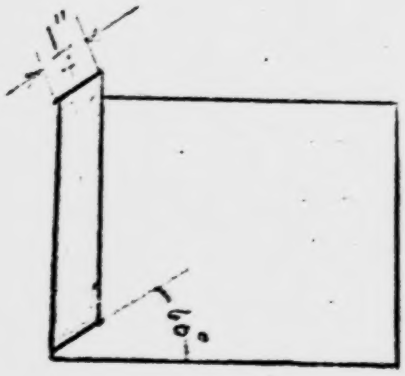


Fig. 3 Sharp-angle bend made with hand seamer.

FOR THE STUDENT

No. I 108

HAND TOOLS AND SIMPLE MACHINES

CUTTING BAND IRON USING THE BENCH SHEAR

Objective:

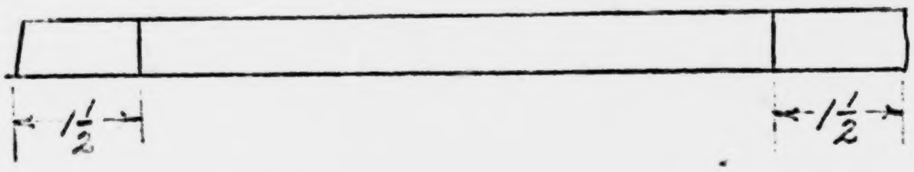
Given a bench shear and three pieces of 1/8" x 1/2" band iron, you will measure 1½" from each end of the pieces and remove that metal by shearing it with the bench shear.

Introduction:

The bench lever shears with straight blades are used for cutting band or strap iron and black iron sheet. Never cut nails, rivets, or bolts with these shears. Most shears found in school shops, have at least a 10 gauge (9/64") cut off capacity and blades that will cut widths of 3½ inches. When using the shears, always observe the safety rules.

Activity:

1. Using layout tools measure 1½ inch from the ends of each piece. Scribe the lines heavily; this will enable you to see them clearly when lining it between the cut-off blades of the shear. See Fig. 1.



2. Now you are ready to shear off the metal. Open the blades by pushing back the handle of the shear. See Fig. 2.

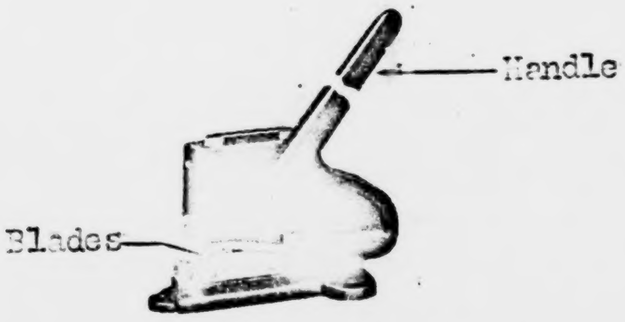


Fig. 2 Bench lever shears

3. Insert the metal with the layout line directly over the shearing edge, and then carefully lower the handle to cut the metal.

4. When you have finished cutting all pieces, measure the finished metal. They should all be 14 inches in length.

5. If your work is correct, inform the teacher that you are finished.

FOR THE STUDENT

No. I-112

HAND TOOLS AND SIMPLE MACHINES

FORMING SHEET METAL ON THE FORMING ROLLS

Objective:

Given two pieces of 4" x 10" 26 ga. sheet metal and a slip-roll forming machine, you will form a plain cylinder and a cylinder with a fold on both ends.

Activity:

1. View the film strip, "Sheet Metal Forming and Seaming."

FORMING A CYLINDER

2. Go to the forming rolls and lock the upper roll in position. Adjust the lower roll to a position parallel to the upper roll. See Fig. 1a and 1b. Leave just enough clearance between the rolls for the metal to slip in under slight pressure.

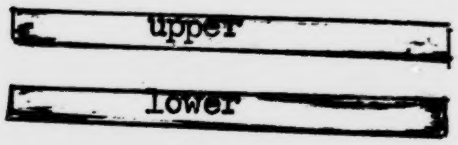


Fig. 1A Right position.

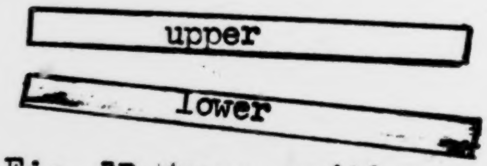


Fig. 1B Wrong position.

3. Adjust the back roll by raising it with two turns of the adjusting screws. Make sure the back is parallel to the other rolls. See Fig. 2.

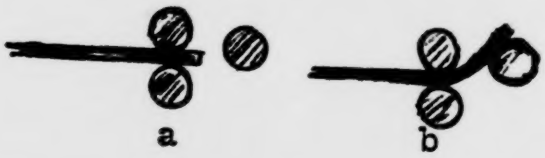


Fig. 2. Forming a cylinder

4. Insert the sheet metal between the front rolls, and turn the handle. Just as the metal enters, raise it slightly to start the forming, and then lower it to catch the back roll.

5. Continue turning the handle to shape the cylinder. If the cylinder is not small enough, bring the sheet back to the starting position. Readjust the back roll by raising it again with two turns of the back roll adjusting screws.

6. When the cylinder is formed, release the upper, or slip, roll to remove the metal.

ROLLING A CYLINDER WITH A FOLD ON BOTH ENDS

7. Loosen the slip roll and insert the metal, with one bend just inside the rolls. The back roll must be lowered quite far. See Fig. 3.

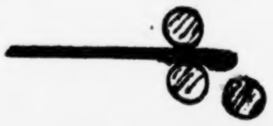


Fig. 3 Back roll is lowered to allow metal with a folded end be positioned.

8. Lift the sheet slightly by hand, and turn the handle. When the fold is past the back roll, turn up the back roll by two turns of the back roll adjusting screws. Now turn the handle forward to form it.

9. It is usually a good idea to form the cylinder to a size slightly larger than the finished one. Then, by adjusting the back roll, you can bring the cylinder to finished size by rolling it back and forth.

10. When you are finished, turn your work in to your instructor for checking.

TEACHER REFERENCE SHEET FOR STUDENT PACKAGE

For this package, the student will need:

1. Two pieces of 4" x 10" 26 ga. sheet metal.
2. A film strip, "Sheet Metal Forming and Seaming."

MEDIA:

The film strip, "Sheet Metal Forming and Seaming," is in black and white and consists of 46 frames. The film strip gives detailed steps for using the slip-roll forming machine. It can be purchased from McGraw-Hill Films, 330 West 42nd Street, New York, New York, 10036. Cost of film strip is $6.00.

FOR THE STUDENT

No. I 116

HAND TOOLS AND SIMPLE MACHINES

ROTARY MACHINE ROLLS IDENTIFICATION

Objective:

—Given a transparency of five commonly used forming rolls, you will be able to identify and select the proper set of rolls for wiring an edge, burring, beading, and crimping.

Activity:

Several of the sets of rolls look similar. Take your time and view each set carefully.

1. Place the transparency on the projector, turn on the projector and view the first set of rolls, the turning rolls. The turning rolls are used to prepare a seat to receive a wire, see Fig. 1.
2. View the second set of rolls, the burring rolls. These rolls are used to make a flange and a burr on a bottom to be attached to a cylinder, see Fig. 2.
3. View the third set of rolls, the wiring rolls. These rolls are used to close a wired edge around a wire, see Fig. 3.
4. View now the fourth set of rolls, the crimping rolls. They are used on the ends of cylindrical objects, particularly heating pipes. It is the process of drawing in the edge so that it will slip into the next pipe easily, see Fig. 4.
5. View the fifth set of rolls, the beading rolls. These rolls are used to strengthen and decorate containers, see Fig. 5.

Post test:

6. Review steps 1 thru 5. When finished, go the equipment bin and get the five sets of rolls, and the 5 pieces of bent material. Match each piece of metal to the roll that made the bends.
7. Inform the teacher you are finished. After he reviews your matched pair, proceed to package No. I 117.

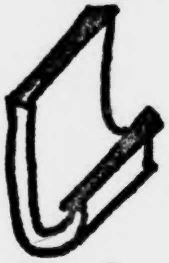


Fig. 1

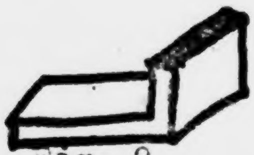


Fig. 2

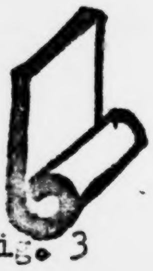


Fig. 3

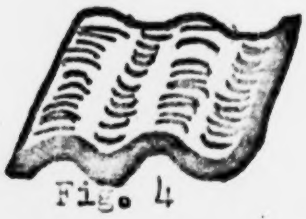


Fig. 4

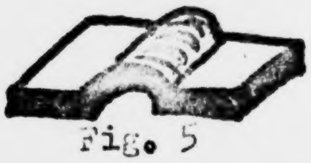
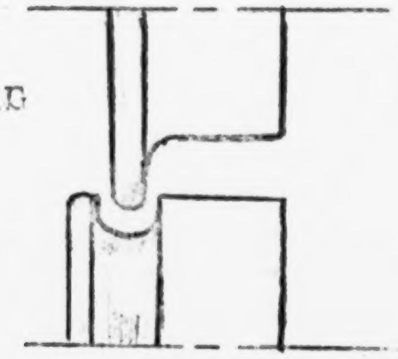


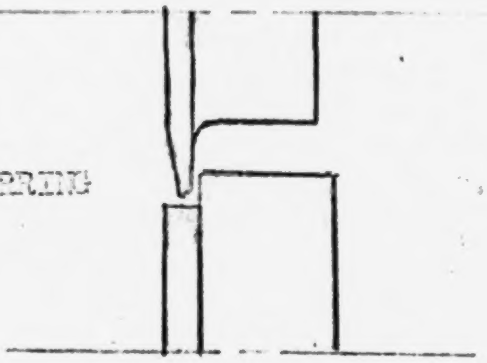
Fig. 5

ROTARY MACHINE ROLLS IDENTIFICATION No. I 116

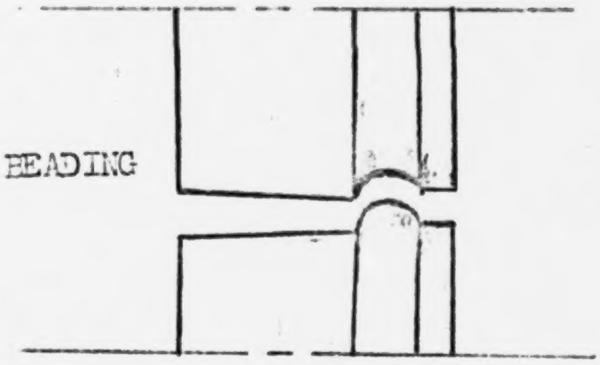
1. TURNING



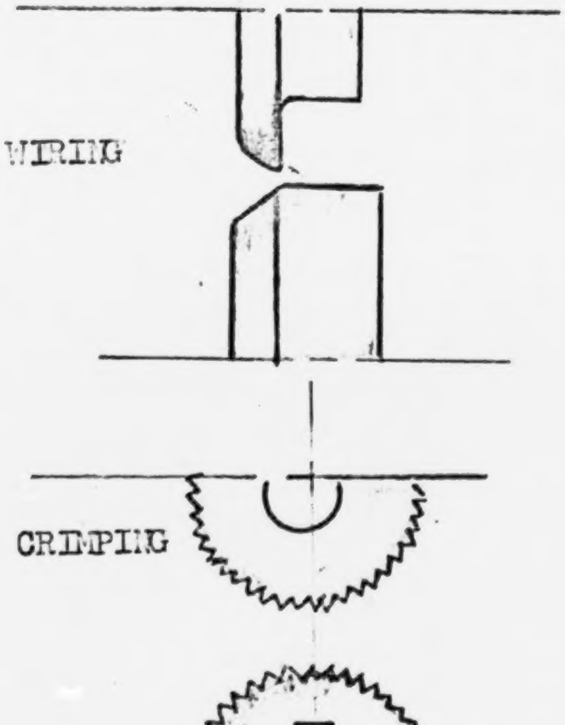
2. BURRING



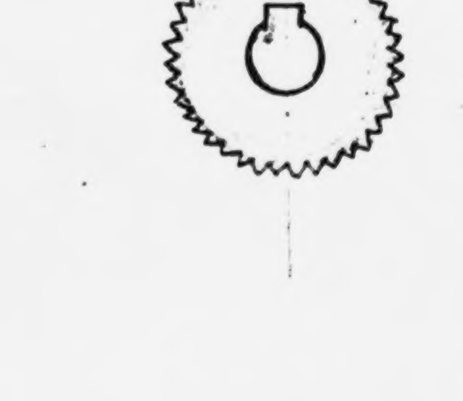
5. BEADING



3. WIRING



4. CRIMPING



TEACHER REFERENCE AND INFORMATION FOR PACKAGE No. I 116

1. For this package the student will need a transparency of the five rotary machine rolls, an overhead projector, and 5 pieces of metal pre-bent as in Figs. 1—5 on page one of this package.

   The transparency can be made from the sheet included in this package with drawings of the five rolls.

FOR THE STUDENT

No. I-117

HAND TOOLS AND SIMPLE MACHINES

WIRING AN EDGE, TURNING A BURR, BEADING, AND CRIMPING, USING A COMBINATION ROTARY MACHINE

Objective:

Given a combination rotary machine, one piece of No. 10 mild steel wire 5 1/2" long, five 3" x 5" pieces of 26 ga. sheet-metal, and sets of rolls for turning, burring, wiring, beading, and crimping, you will:

1. Wire an edge. Work should be firmly wrapped around wire without a burred edge exposed.
2. Turn a flange and a burr.
3. Strengthen or decorate a piece of metal by beading it. Bead should be 1/4" deep.
4. Crimp the end of a piece of metal. Make crimp to fit properly into the end of a crimped pipe.

Prerequisite:

Complete Package No. I 116 before doing this package.

Activity:

1. Go to the equipment bin and select a set or turning, wiring, burring, beading, and crimping rolls.

TURNING AN EDGE

2. Install the turning rolls. Set the gauge a distance equal to two and one-half times the diameter of the wire from the center of the groove (2 1/2 x 1/8=5/16").

Note: To install rolls, first loosen the collar using the face spanner wrench (this wrench is attached to the machine on the end of a chain). Unscrew the collar and remove. Slide on the rolls, making sure they are placed properly. Now screw on the collar and tighten it with the face spanner wrench. If you need assistance, call the teacher.

3. Slip the metal between the rolls and against the gauge. Tighten the upper roll until it grips the metal.

4. Hold the metal against the gauge with your left hand, and turn the handle with your right hand. Make one complete turn. The metal must track the first time. Never let it roll off the edge of the metal.

5. Continue tightening the upper rolls after each turn. Raise the cylinder until the edge is U-shaped to receive the wire.

6. Loosen the upper roll to remove the piece of metal from the machine.

CLOSING THE WIRED EDGE WITH THE WIRING ROLLS

7. Place the wiring rolls on the machine. Adjust the gauge a distance from the sharp edge of the upper roll equal to the diameter of the wire plus twice the thickness of the metal (approximately 3/8").

8. Place the wire in the edge, with one end sticking out about 1/2 inch. Then, with pliers, squeeze the edge for a distance of about 1/2 inch to fasten the wire in place. See Fig. 1.

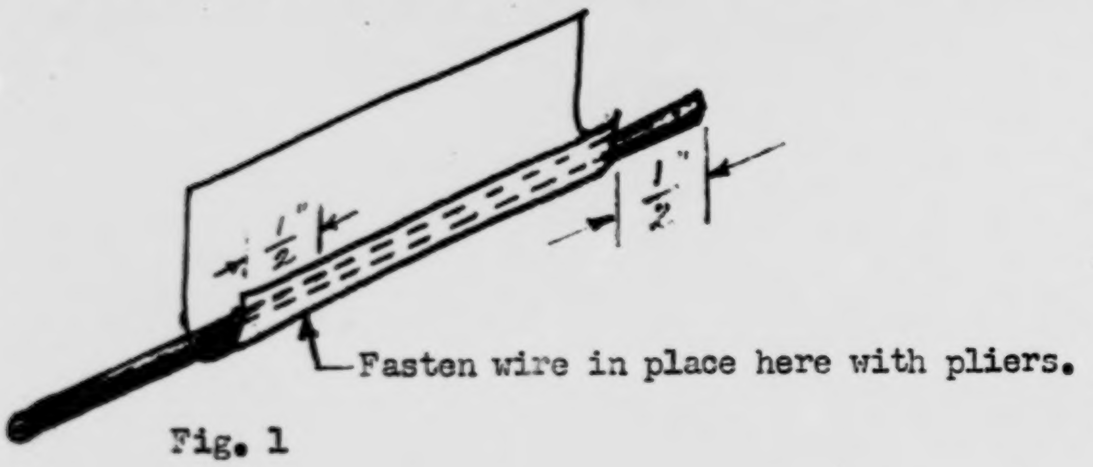


Fig. 1

9. Place the work between the rolls, with the wired edge up and against the gauge. Tighten the rolls at the point where the edge is already squeezed down.

10. Turn the handle as you feed in the work to set the wired edge.

11. Loosen the upper rolls and remove the work.

TURNING A BURR OR FLANGE

12. Place the burring rolls on the rotary machine. Adjust the upper and lower rolls. The distance between the sharp edge of the upper roll and the shoulder of the lower roll should equal the thickness of the metal used.

13. Set the gauge away from the shoulder of the lower roll by a distance equal to slightly less than the measurement of the burr. For example, for a 1/8" burr, adjust to slightly less than 1/8"

14. Bend a little piece of scrap metal into a U shape to protect your hand from being cut by the sharp burr. Place this in the round of your hand between thumb and forefinger. Grasp the metal between the thumb (on top) and the forefinger (below) on or toward the center of the piece of metal.

15. Hold the metal firmly against the gauge and turn the upper roll down until slight pressure is applied to the metal.

16. Turn the handle slowly, carefully tracking the burr.

17. Apply a little more pressure by tightening the upper roll. Then turn the handle with a little more speed as you slowly r aise the metal from a horizontal to an almost vertical position.

18. Continue to tighten the upper roll and turn until the burr is formed.

19. Loosen the upper roll to remove the metal.

20. To turn a flange on a piece of metal is a similar operation, except that the edge is turned only 90 degrees.

BEADING

21. Place the rolls on the rotary machine. Set the gauge a distance of 1¼" from the edge for the correct location of the bead.

22. Tighten the upper roll to apply enough pressure to form the metal lightly.

23. Turn the handle, tracking the bead the first time. Continue tightening the upper roll until the bead is completely formed.

CRIMPING

24. Place the crimping rolls on the rotary machine, and adjust the gauge a distance of 1" from the edge for the correct length of the crimp.

25. Slip the piece of metal between the rolls, with the edge against the gauge.

26. Apply moderate pressure with the upper roll, and turn the handle to form the first impression.

27. Apply more pressure to deepen the crimp, making sure that the crimping folls follow the first impression.

28. You are now finished. Take your pieces to the instructor for checking.

FOR THE STUDENT No. I-128

HAND TOOLS AND SIMPLE MACHINES

CHISELS AND CALIPERS IDENTIFICATION

Objective:

Given pictures of a gouges, skew chisels, spear point, parting tool, square nose chisel, round nose chisel, bearding tool, dividers, inside calipers, outside calipers, you will name each tool for your teacher.

Activity:

1. Take the set of pictures named "chisels and calipers", and give each tools name. Turn the picture over and read the correct name on the back, to see if you are correct.
2. Repeat until you can name all tools from memory.
3. Go to your tool panel and find these tools.
4. Name them for your teacher aide.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-128

1. For this package the student will need:

   (a) Ten pieces of cardboard 8" X 6".
   (b) A picture of the following tools: (5" X 7")

       1. gouges
       2. skew chisels
       3. spear point
       4. parting tool
       5. square nose chisel
       6. round nose chisel
       7. bearding tool
       8. dividers
       9. inside calipers
       10. outside calipers

   (c) Folder with the following words on the front. (large letters)
       1. Chisels and calipers

2. Explanation:

Pictures should be attached to cardboard with the name of each tool on the back of the cardboard. The entire card laminated and placed in the folder.

FOR THE STUDENT No. I-132

HAND TOOLS AND SIMPLE MACHINES

CUTTING WITH THE SCROLL SAW

Objective:

Given a scroll saw, a pattern, wood, and this package, you will cut the wood according to the pattern, (+ - 1/8"), following safety procedures as specified.

Activity:

1. If you think you can operate the scroll saw, get some scrap wood, and a blade, go to the scroll saw and demonstrate to the teacher your ability to operate and cut patterns to shape.

    (A) If successful you are done.
    (B) If unsuccessful, go to number two.

2. Take the slide projector and tape recorder and review the slide presentation "Safe Use of the Scroll Saw". Repeat until you are sure you can do the following:

    (A) Dress properly for use of the machine.
    (B) State the meaning of the safety zone.
    (C) Turn the machine on and off.
    (D) Check to be sure the belt guard is in place.
    (E) Level the table.
    (F) Install the blade.
    (G) Adjust the hold down clamp
    (H) Adjust the saw speed.
    (I) Hold the stock so that your hands are to the side of blade.
    (J) Cut the stock according to the pattern.
    (K) Clean the machine.

3. Show the finished work to your teacher.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE

VISUAL	NARRATION
1. Main Title: THE SCROLL SAW	
2. Sub Title: SAFETY	Before attempting to operate any machine we must be sure that we can operate it safely.
3. M.C.U. student and teacher.	Before using any machine in shop get permission from the teacher.
4. C.U. taking off ring.	Be sure to remove rings and---
5. C.U. taking off watch	watches before operating any machine.
6. Student with apron M.C.U.	Any loose clothing, such as ties, are tucked in or covered up.
7. Student rolling sleeves M.C.U.	Sleeves are rolled above the elbow.
8. Safety Zone M.C.U.	The safety zone means that no one except the operator can be in that area when the machine is in use.
9. Hand on switch C.U.	No one except the operator turns the saw on and off. Never leave the machine running.
10. Belt Guard in place C.U.	The belt guard should be in place for your protection.
11. Student checking to see if table is level C.U.	Check to see that the table is level so that the cut will be at right angles to the face of your work.

12.	LS of Scroll Saw.	This is the Scroll Saw.
13.	Coping saw held in front of scroll saw C.U.	The scroll saw can be used in place of the hand coping saw.
14.	C.U. of Motor.	The scroll saw is powered by an electric motor.
15.	Blade in place C.U.	The cutting blade is small and travel up and down through the table.
16.	M.C.U. of cut curves.	The machine is designed to cut curves in wood.
Title Slide		THE SET UP
17.	Table adjustment lever with hand on it C.U.	The machine table should be set at the desired angle-- generally level.
18.	C.U. of Blade.	The teeth of the blade must point down when placed in the saw.
19.	Hand adjusting hold down clamp C.U.	Adjust the hold down clamp by loosening the thumb screw --Let the clamp rest on the wood--tighten the thumb screw.
20.	Hand adjusting speed control C.U.	To adjust the saw speed turn the handle.
21.	Hand turning saw by hand C.U.	Turn saw by hand before starting motor.
Title Slide		CUTTING
22.	Person in proper position M.C.U.	The operator should stand directly in front of the machine.
23.	Hands holding stock in cutting position C.U.	Hold the stock so that your hands are to the side of the blade.
24.	Radius drawn on wood smaller than blade C.U.	Do Not try to cut a corner too small for the blade.

25.	Cut wood to sharp 90° corner C.U.	Do not attempt to cut around a square corner. Take one cut. Back the wood out and cut in from other direction.
26.	Drilling hole in wood. C.U.	When making an internal cut ---first drill a hole in the material to be removed.
27.	Hand holding Hold Down Clamp and placing wood over blade C.U.	Raise the Hold Down Clamp and insert the blade thru the hole--adjust the Hold Down clamp on stock.
28.	Hand on switch C.U.	When finished cutting turn off the machine. Never leave running.
29.	Brush cleaning saw C.U.	Clean the machine with a brush after using.

FOR THE STUDENT

No. I 150

HAND TOOLS AND SIMPLE MACHINES

LAYOUT TOOLS IDENTIFICATION

Objective:

Upon successful completion of this package, you will identify the commonly used metal working layout tools, and state the main use of each.

Introduction:

Laying-out is the marking of lines, circles, and arcs on metal surfaces; such work is called layout work. The tools used for making a drawing on metal are layout tools. The transparency included in this package will show you some layout tools. Descriptions of the layout tools that are most often used and their uses are given in the section that follows.

Activity:

1. Take the transparency over to the overhead projector and view the seven layout tools shown.

2. Now view each tool again after reading a brief description of its use.

Ⓐ COMBINATION SQUARE: The combination square has many uses. It can be used for laying out lines at 45 or 90 degree angles, for checking the squareness of stock, for measuring depths, and for use as a marking gage. There is a spirit level in the head for leveling up a machine or a workpiece. The steel rule may be removed and used for measuring or marking out distances.

Ⓑ BALL PEEN HAMMER: A hammer is used for striking, driving, and pounding. The ball peen is used the most--the flat face for general work and the rounded end for riveting and peening. In laying out work, the hammer is used for striking the prick or center punch.

Ⓒ DIVIDERS: Dividers are used like a compass to lay out circles and arc. They are used primarily to mark the size and location of holes to be drilled. They may be used to divide lines or circles into a number of smaller, equal parts, or to measure distances.

(D.) SCRIBER: The scriber is a slender steel rod about 8 to 12 inches long with a sharp point on one or both ends. Sometimes one end is bent at a right angle. The scriber is used to scribe, or scratch, lines on most metal surfaces.

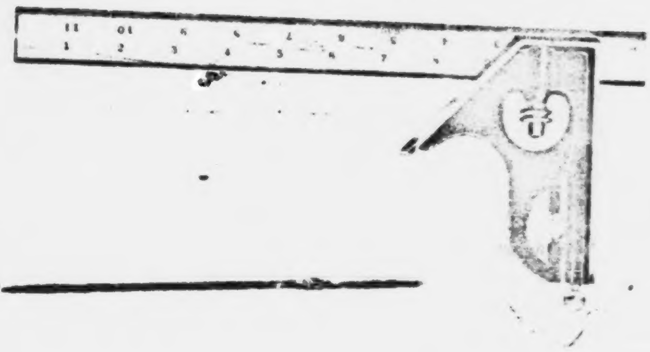
(E.) CENTER PUNCH: The center punch has a 60 or 90 degree ground point on one end. It is used to make an indentation, so that the drill will start easily and correctly at the previously layed-out mark.

(F.) STEEL SQUARE: A large steel square is very useful in sheet metal work. Whenever layed-out points on large sheets of metal need to be joined, the straight edge of a square is held along these points and a line is scribed. Measuring and marking can be done with a steel square.

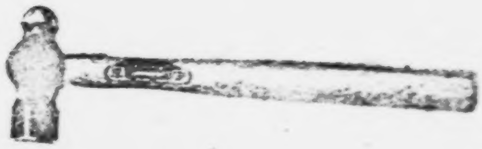
(G.) STEEL RULES: The steel rule is one of the most useful tools in the shop. The most commonly used rules are the 6 and 12 inch length. The edges are divided by fine lines into different parts of an inch, such as 8ths, 16ths, 32nds, and 64ths of an inch. The smallest division is 1/64", the next larger is 1/32", the next is 1/16", then 1/8", 1/4", and 1/2". The divisions are called graduations. When measuring or marking out distances, the rule must be held on edge to be accurate. If the end is worn, start reading from the one inch mark.

3. POST TEST: Take the post test. Be sure and read the instructions. When finished give it to the instructor for checking.

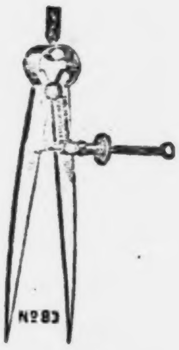
LAYOUT TOOLS IDENTIFICATION



A. ____________________

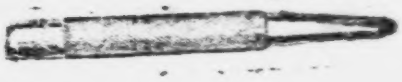


B. ____________________

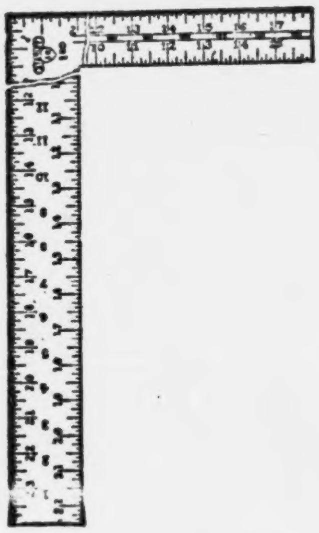


C. ____________________

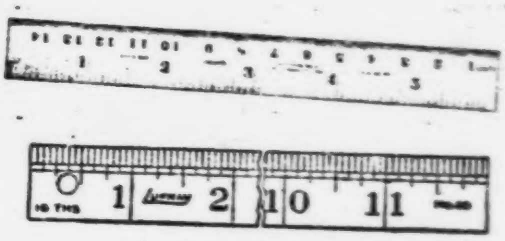
D. ____________________



E. ____________________



F. ____________________



G. ____________________

POST TEST

Instructions: Look at the transparency. List below the name of each tool and explain how that tool is used in the metal shop.

A. ____________________

B. ____________________

C. ____________________

D. ____________________

E. ____________________

F. ____________________

G. ____________________

FOR THE STUDENT No. I-152

HAND TOOLS AND SIMPLE MACHINES

MAKING A SIMPLE LAYOUT

Objective:

Given a piece of 10 1/2" x 12 1/2" 26 ga. sheet metal, a drawing of a utility box, and layout tools (combination square, scriber, steel rule, and steel square), you will transfer the measurement information from the drawing to the sheet metal, to an accuracy of ±1/8".

Prerequisite:

You must have successfully completed Packages NO. I-150, "Layout Tools Identification," and No. I-151, "Measuring With a Steel Rule."

Introduction:

Measuring and marking stock are the first steps in making any product. It is important that you measure and use the layout tools correctly. The film strip that you are to view, will be a great help to you in completing this package.

Activity:

1. View the film strip, "Sheet Metal Laying Out and Cutting."
2. Take the drawing of the utility box, the piece of sheet metal, and the layout tools over to the sheet metal bench.
3. Hold the rule on the surface of the metal. Make sure the rule is kept parallel to sides of the metal, so the exact length can be obtained.
4. Now measure and mark 1/4" on each side of the metal for lines 1, 2, 3, and 4.
5. Hold the combination square firmly against the side of the workpiece and scribe the lines 1, 2, 3, and 4. Turn the scriber at a slight angle, so that the point will touch the lower edge of the rule.

   NOTE: You perhaps have noticed lines 2 and 4 are longer than the other two and the combination square does not help you to scribe a line the length of the metal. The steel square can be used to help scribe lines 2 and 4. You must measure and mark twice along the surface of the metal for these two lines. Now hold the edge of the steel square over these marks and scribe the lines, see Figure 1.

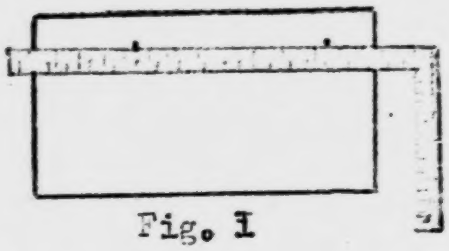
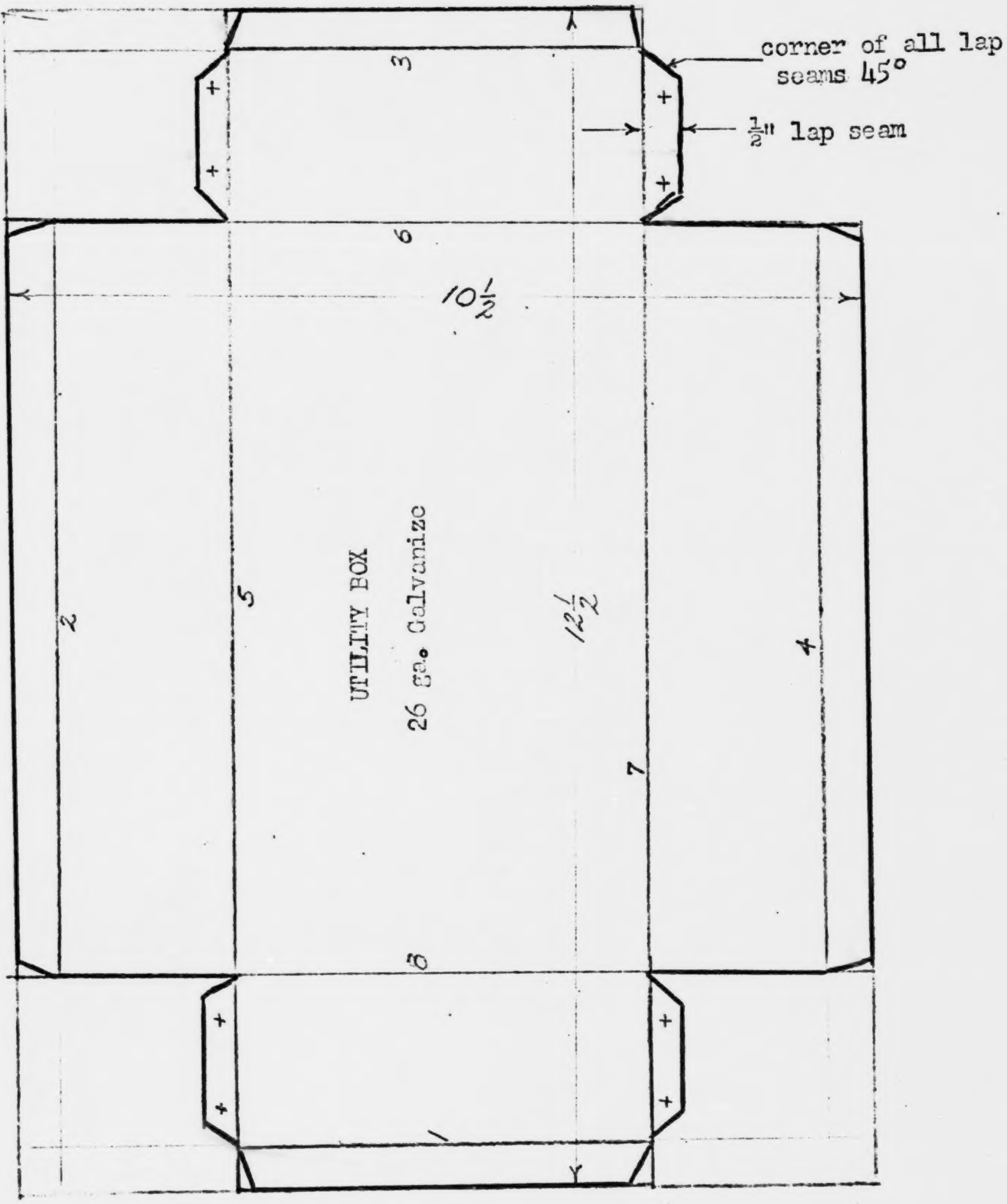


Fig. 1

6. Measure 2 1/4" from the sides of the workpiece or measure 2" from lines 1, 2, 3, and 4, and mark.
7. Use the combination square and scriber to scribe lines 7 and 8.
8. Use the steel square and scriber to scribe lines 5 and 6. Remember to measure and mark twice along the workpiece, again see Figure 1.
9. Measure 1/2" from lines 5 and 6, mark and scribe lines. You are laying out for the lap seams.
10. Scribe the 45 degree corner lines on each lap seam. This can be done by removing the head from the combination square and using the 45 degree angle of the head. If help is needed for this operation, ask your teacher or the teacher aide for assistance.
11. You are now finished. Check your workpiece with the drawing. It should be exactly like the drawing.
12. Give your work to your teacher for checking.

NOTE: After the workpiece has been checked and returned to you, save it. You will use the workpiece for Package No. I-103, "Bending Sheet Metal On The Box and Pan Brake."


corner of all lap seams 45°
½" lap seam
1
2
3
4
5
6
7
8
10½
12½
+
UTILITY BOX
26 ga. Galvanize

TEACHER REFERENCE AND INFORMATION FOR PACKAGE

1. For this package the student will need:

   A. 1 piece of 10 1/2" x 12 1/2" 26 ga. sheet metal.

   B. Layout Tools--combination square, scriber, steel rule, and steel square.

   C. A film strip, "Sheet Metal Laying Out and Cutting."

2. MEDIA:

   The film strip, "Sheet Metal Laying Out and Cutting," is good for this package. It shows step-by-step procedure for laying out a pattern on metal using the steel rule, scriber, dividers, and combination square. It is available in black and white and has 45 frames. Cost it $6.00.

   Purchase from: McGraw-Hill Films
   330 West 42nd Street
   New York, New York 10036

FOR THE STUDENT No. I 153

HAND TOOLS AND SIMPLE MACHINES

MEASURING THE THICKNESS OF SHEET METAL AND WIRE USING SHEET METAL GAGES

Objective:

Given a United States Standard Gage, an American Standard Wire Gage, two sheet metal samples of iron, steel, copper, aluminum, and two wire samples of steel, and copper, you will measure the thickness of all samples. Your answer must be the same as the standard gauge number determined for these pieces of metal.

Introduction:

Sheet metal gauges are round disks of metal with slots cut around the outside. They are used to measure the thickness of sheet metal and wire. Each slot is numbered. The sheet metal or wire gauge is the same number as the slot which it fits. The decimal equivalent of the number is one the other side of the gage, see Fig. 1A and 1B.

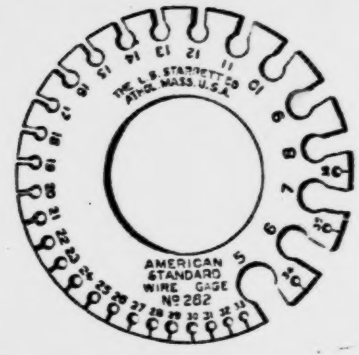

THE L.S. STARRETT CO. ATHOL MASS. U.S.A.
AMERICAN STANDARD WIRE GAGE
Nº 282

Fig. 1A

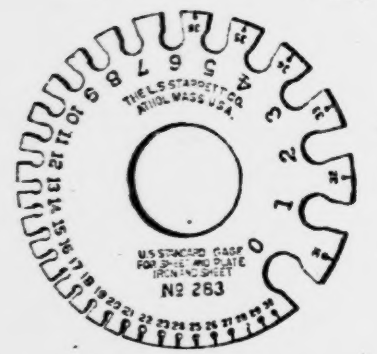

THE L.S. STARRETT CO. ATHOL MASS. U.S.A.
U.S. STANDARD GAGE FOR SHEET AND PLATE IRON AND STEEL
Nº 283

Fig. 1B

The United States Standard (USS) gage is used for black and galvanized mild-steel sheets, steel plates, and steel wire. The American Standard Wire gage, also called Browne & Sharpe, is used to measure non ferrous metals such as copper, brass, and aluminum. Both gages look alike, so be careful in selecting one for measuring purposes.

Activity:

- Instructions: Record the gage number and decimal equivalent of each sample on page 2 in the space provided. When finished with the activity section, check your readings with the answer sheet provided with this package.

1. Select the United Standard gage, the wire and sheet samples of iron, and steel. Measure each. How do they fit? See Fig. 2. Record your readings.

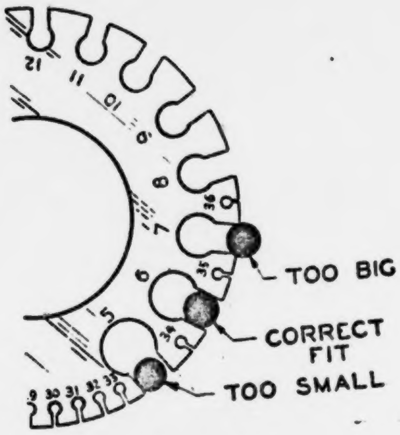


Fig. 2

2. Select the American or Browne & Sharpe gage and the samples of sheet copper, aluminum, and the wire samples of copper. Measure each. Record your readings.
3. Check your measurements by repeating steps 1 and 2. When finished, check your readings you have listed below with the answer sheet.

MEASUREMENTS OF SHEET AND WIRE SAMPLES		
	GAGE NUMBER	DECIMAL EQUIVALENT
SHEET STEEL SAMPLES	1 ______ 2 ______	______ ______
SHEET IRON SAMPLES	1 ______ 2 ______	______ ______
SHEET COPPER SAMPLES	1 ______ 2 ______	______ ______
SHEET ALUMINUM SAMPLES	1 ______ 2 ______	______ ______
STEEL, WIRE SAMPLES	1 2 ______	______
COPPER WIRE SAMPLES	1 2 ______	______

TEACHER REFERENCE AND INFORMATION FOR PACKAGE No. I 153

For this package the student will need:

A. 2 - 2" x 2" sheet samples of iron, steel copper, and aluminum, with gages as listed below.

B. 2 - 3" long wire samples of steel and copper, gages as listed below.

C. Gages - United States Standard and American Standard Wire.

ANSWER SHEET

Sheet Steel samples	1.	22 ga.	.0313
	2.	26	.0188
Sheet Iron samples	1.	15	.0703
	2.	18	.0500
Sheet Copper samples	1.	20	.0320
	2.	22	.0253
Sheet Aluminum	1.	24	.0201
	2.	26	.0159
Steel Wire samples	1.	10	.1350
	2.	12	.1055
Copper Wire samples	1.	8	.1285
	2.	10	.1019

FOR THE STUDENT

No. I-200

HAND TOOLS - SIMPLE MACHINES

COMMONLY USED HAND SAWS: NAMES AND USES

Objective:

When you have learned the material presented in this series, you will be able to:

1. Select a hand saw, coping saw, hack saw, and back saw from an assortment of hand tools.
2. Correctly name out loud each of these hand tools.
3. Correctly state a use for each hand saw.

Activity:

1. Take the slide presentation numbered 1-200 to a study carrel where you can view the material by yourself. In order to help you learn this new information, answer out loud the questions on the audio tape.
2. When you have finished viewing the presentation, and you can do the three (3) tasks above, follow the last set of instructions given in the presentation.

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE No. I-200

Slide No.	Visual	Audio
1.	None	You are going to be shown four types of commonly used hand saws. If you know the name and use of each saw, take them out of the tool locker, bring them to the shop foreman, and tell him the name and use of each.
2.	Back Saw	Saw number 1.
3.	Hand Saw	Saw number 2.
4.	Coping Saw	Saw number 3.
5.	Hack Saw	Saw number 4.
6.	word, Stop	If you know the name and use of each of the hand saws just shown, stop this machine, take the saws out of the tool locker, bring them to the shop foreman and tell him the name and use of each of these saws. If not, continue.
7.	None	Let's look at each of these saws and learn its name and use.
8.	Back Saw	This saw is used for cutting small pieces of wood. It is called ...
9.	Back Saw with title	...(5 second pause) a back saw. A back saw is used for cutting small pieces of wood.
10.	Hand Saw	This saw is used for cutting large pieces of wood. It is called...
11.	Hand Saw with title	...(5 second pause) a hand saw. A hand saw is used for cutting large pieces of wood.
12.	Coping Saw	This saw is used for cutting curves in wood. It is called...
13.	Coping Saw with title	...(5 second pause) a coping saw. A coping saw is used for cutting curves in wood.

14.	Hack Saw	This saw is used for cutting metal bars, rods, and pipe. It is called...
15.	Hack Saw with title	...(5 second pause) a hack saw. A hack saw is used for cutting metal bars, rods, and pipe.
16.	Question mark (?)	Do you know the names of the four types of commonly used hand saws? Do you know the use for each of them too? Let's look at each one one more time.
17.	Back Saw	What is the name of this saw?
18.	Back Saw with title	...It is a back saw.
19.	Back Saw being used	A back saw is used for cutting small pieces of wood. (Dub in sound of saw cutting wood.)
20.	Hand Saw	What is the name of this saw?
21.	Hand Saw with title	...It is a hand saw.
22.	Hand Saw being used	A hand saw is used for cutting large pieces of wood. (Dub in sound of saw cutting wood.)
23.	Coping Saw	What is the name of this saw?
24.	Coping Saw with title	... It is a coping saw.
25.	Coping Saw being used	A coping saw is used for cutting curves in wood. (Dub in sound of saw cutting wood.)
26.	Hack Saw	What is the name of this saw?
27.	Hack Saw with title	...It is a hack saw.
28.	Hack Saw being used	A hack saw is used for cutting metal bars, rods, and pipe. (Dub is sound of saw cutting metal.)
29.	Question mark (?)	Do you now know the names and use of all of the commonly used types of hand saws?
30.	Back Saw	Saw number 1.

31.	Hand Saw	Saw number 2.
32.	Coping Saw	Saw number 3.
33.	Hack Saw	Saw number 4.
34.	none	If you know the name and use of the four hand saws just shown, take these saws out of the tool locker, bring them to the shop foreman and tell him the name and use of each of these tools...(5 second pause) If you don't know the name and use of each of these hand saws, look at this lesson again.
35.	THE END	Wind the tape on the recorder until the machine stops. Then return it with the slides to the class librarian

FOR THE STUDENT

HAND TOOLS - SIMPLE MACHINES

VERBAL IDENTIFICATION: POWER HACK SAW, JIG SAW, BAND SAW, TABLE SAW, AND RADIAL ARM SAW.

Objective:

Given a package of five (5) photographs of five (5) power saws found in the shop, and a teaching assistant who knows the names of each of these five (5) power saws, you will state the name of each of these power saws as they are pointed out to you.

Pretest:

As you look at each photograph, state the correct name of each power saw to the teaching assistant who is sitting beside you. If you get all the names right, you have passed. If you did not, continue.

Activity:

1. Give the photographs to the teaching assistant.
2. As the teaching assistant shows you each picture, state the name of the object.
3. If you are correct, the teaching assistant will tell you. If you are not correct, he will tell you the correct name of the object.
4. Repeat steps 2 and 3 until you can correctly state the names of the objects in the photographs.

Post test:

As the teaching assistant takes you to look at the five (5) power saws in the shop, tell him the correct name of each one.

FOR THE STUDENT

No. I-205

HAND TOOLS - SIMPLE MACHINES

VERBAL IDENTIFICATION: HAND DRILL, ELECTRIC DRILL, DRILL PRESS, AND HAND BRACE

Objective:

Given a package containing a photograph of; a hand drill, electric drill, hand brace, and drill press, and a teaching assistant who knows the names of each of these four (4) drilling and boring tools, you will select each tool from the tool locker and state its name.

Pretest:

The teaching assistant will ask you to go to the tool locker and get a hand drill, hand brace, and electric drill, and to lead him to the drill press. If you can do this, and state the name of each tool, you need not continue. If you cannot do this, then do steps one through four below.

Activity:

1. Give the photographs to the teaching assistant.
2. As the teaching assistant shows you each picture, state the name of the object shown in the picture.
3. If you are correct, the teaching assistant will tell you. If you are wrong, the teaching assistant will tell you the correct name.
4. Repeat steps 2 and 3 until you can correctly state the names of the objects in the pictures.

Post test:

Select these tools from the locker and state their correct name before you show them to the teaching assistant. If the tool is not in the locker but is in another place in the room, lead the teaching assistant to it and tell him the correct name of the tool.

HAND TOOLS - SIMPLE MACHINES

VERBAL IDENTIFICATION: C CLAMP, PARALLEL CLAMP, MACHINISTS VISE, WOODWORKING VISE, BAR CLAMP, HAND SCREW CLAMP AND MITRE-FRAME CLAMP.

Objective:

Given a package containing pictures of the following holding devices; a bar clamp, C clamp, parallel clamp, machinists vise, woodworking vise, hand screw clamp and mitre-frame clamp, and a teacher assistant who knows the names of each of these tools, you will select each tool from the tool locker and state its name and use, or if the tool is not in the tool locker, you will show the teacher asistant a picture of it and tell him its use.

Pretest:

Go to the tool locker, select the tools listed above, and take them to the teacher asistant. Tell him the name and use of each tool. If some are missing, show him the picture of that tool and tell him its name and use. If you cannot do this, go directly to the activity.

Activity:

1. Give the photographs to the teacher assistant.
2. As the teacher assistant shows you each photograph, tell him the correct name and use of each tool in the picture.
3. If you are right, the teaching assistant will show you another photograph of a different tool. If you are wrong, he will tell you the name and use of the tool in the photograph.
4. Repeat steps 3 and 4 until you can state the correct name and use of each tool in the photograph.

Post-test:

Find someone else in your class who doesn't know the names and uses of these tools. You will become the teacher assistant and help him learn the new information. When he has learned the names and uses, have the first teacher assistant check you both out.

FOR THE STUDENT

No. I-212

HAND TOOLS - SIMPLE MACHINES

USES AND/OR APPLICATIONS OF CLAMPING AND HOLDING DEVICES

Objective:

Given a choice of six holding or clamping devices listed below, you will match each device with the material it is used to hold or clamp down, or the problem it would be used to solve.

C-clamp
woodworker's vise
parallel clamp
mitre-frame clamp
machinist's vise
bar clamp

Prerequisite:

It is recommended that you do package I-211 first.

Pretest:

Correctly match the holding or clamping device in the above list with the use or problem listed below. Write your answer in the space provided.

You use this device to hold or assemble molding. ____________________

You are going to cut a metal bar in half. ____________________

You have to hold a large board on top of a table top. ____________________

You are gluing two large boards together to make a table top. ____________________

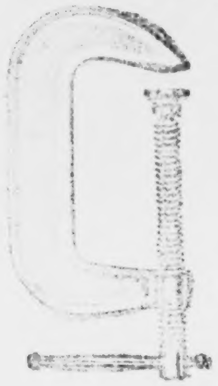
You have to hold a small piece of wood which you will file ____________________

You are fixing a broken chair. ____________________

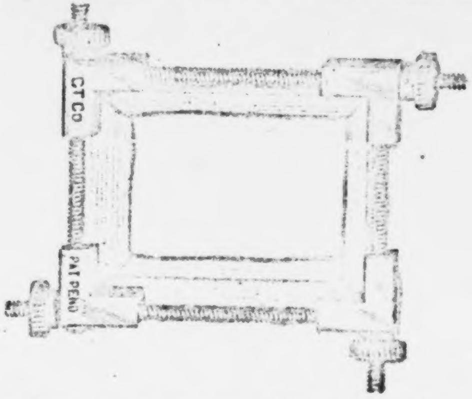
Activity:

You did not get all of the six answers right. Read the information below. Look at the picture of each device you are reading about, it is below each paragraph.

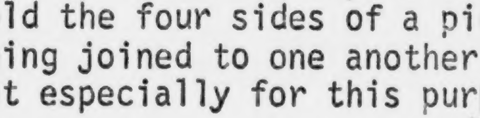
The C-clamp looks like the letter C. It is used to hold two pieces of metal together. It is also used to hold an object to a large surface, such as a table top. Because we are holding or clamping the object with a large amount of force, we position or place a wooden block between the jaw of the clamp and the object. This stops the jaw of the clamp from damaging the object, it will only damage the wooden block.

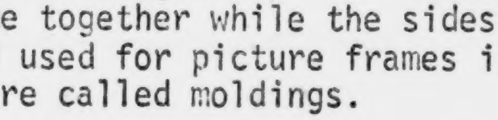


The mitre-frame clamp is also called a molding clamp. It is used to hold the four sides of a picture frame together while the sides are being joined to one another. The wood used for picture frames is cut especially for this purpose and are called moldings.



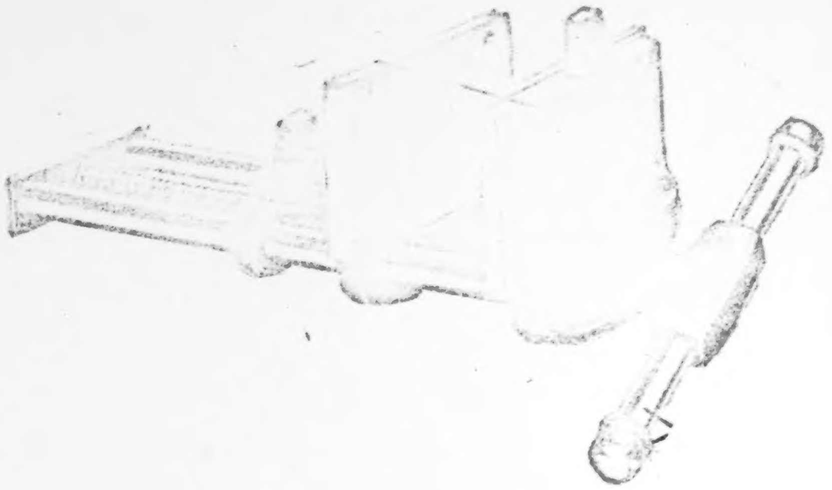
The pictures below are of two types of bar clamps. Bar clamps are usually very long, even as long as you are tall. They look like long bars. They are used to hold two very wide pieces of wood together, or to hold pieces or parts of furniture together while the object is being built or fixed.



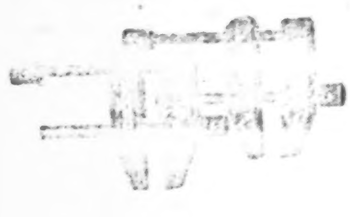


This is a picture of one type of vise. It is called a machinist's vise because the man who uses it works with big metal cutting and shaping machines. This vise is used to hold metal. It can be used to hold metal blocks, rods, bars or metal sheets while they are being cut, polished, or worked on in other ways.

This is a picture of another type of vise.It is called a woodworker's vise because the man who uses it works with wood. This vise is used to hold pieces of wood while they are being cut, filed, sanded or worked on. To protect the soft wood from getting damaged, we attach a woode block to each of the jaws of the vise.



The picture below is of a pair (2) parallel clamps. This pair is made of metal. They are used to hold two metal pieces together and are used by tool-makers. They are called tool-makers paralell clamps. When this type of clamp is made with wood, it is used to hold two pieces of wood together. Wooden parallel clamps are called hand screw clamps.



TEACHER REFERENCE SHEET FOR PACKAGE No. I-212

Pretest:

Below are the correct answers to the pretest in order of the questions asked:

mitre-frame clamp

machinists vise

C-clamp

parallel clamp or hand screw clamp

woodworkers vise

bar clamp

HAND TOOLS - SIMPLE MACHINES

IDENTIFICATION: WIRE STRIPPER AND CUTTER

Objective:

Given a ten inch piece of #12 bell wire and a pair of wire strippers and cutter, you will remove 1½ inches of insulation from each end of the wire without cutting into the wire.

Pretest:

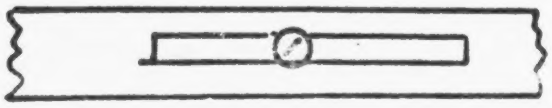
Given a piece of bell wire and a screwdriver and pair of wire strippers and cutters, remove 1½inches of insulation from each end of the wire without cutting into the wire.

Activity:

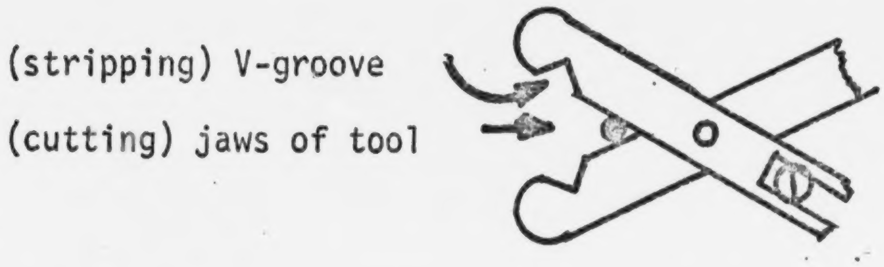
Read the paragraphs below and look at the pictures below each one. When you have done this, get a piece of bell wire and a pair of wire strippers and cutter. Compare this tool with the pictures to be sure that you understand the directions. Then, do the post-test.

The drawing below is of a pair of wire strippers and cutter. The handles of this tool are covered with plastic to protect your hands when you use it to cut wire and/or to remove the protective covering called insulation from the wire.

One of the two handles has a slot in it. There is an adjusting screw in this slot. By untightening this screw with a screwdriver and moving it to a different position in this slot, we make the diamond-shaped opening in the jaws bigger or smaller.



To cut a wire in half or to any length, we place the wire in the jaws of this tool. The wire is placed between the V groove in each of the two jaws and the bottom of the V formed by the two handles. After the wire is in place, squeeze the two handles together by holding the tool in one hand and closing you fist.



To remove or strip the plastic covering called insulation off of the wire, we lossen the adjusting screw and position it so that when we squeeze the handles together, the diamond-shaped opening in the jaws will be the same size as that of the diameter or fatness of the wire.

Place the wire in the V groove of the bottom jaw, leaving 1½ inches of the end of the wire on one side of the groove. Gently squeeze the two handles together to cut into the insulation.

Holding the wire stripper and cutter in one hand, grab the longer end of the wire with your other hand. Pull yourhand with the tool away from you hand holding the wire. Be sure to pull your hand straight out, but don't pull with all your strength. The insulation should slide off of the wire.

If you have done this correctly, you should not have cut into the wire. If you did, practice adjusting the adjusting screw to make the diamond shape a little bit larger. Then repeat the above directions until you can do the task correctly.

Post-test:

In your own words, state to the teacher assistant the several steps involved in using a wire stripper and cutter to cut a wire and to remove the protective covering from it. Also tell him the tool used to adjust it and the steps involved to adjust it to the size of the wire.

FOR THE STUDENT

No. I-215

HAND TOOLS - SIMPLE MACHINES

VERBAL IDENTIFICATION: HAND PUNCH, SOLID PUNCH, BENCH PUNCH, CHASSIS PUNCH, AND HOLLOW PUNCH.

Objective:

Given a package containing photographs of the following hole punching tools; a hand punch, solid punch, bench punch, chassis punch and hollow punch, and a teacher assistant who knows the names and uses of each of these tools, you will select each tool from the tool locker and state its name to the teacher assistant.

Pretest:

The teaching assistant will ask you to go to the tool locker and get a hand punch, solid punch, chassis punch and hollow punch. You will then locate the bench punch. As you show the teacher assistant each tool, tell him the name and use of each one. If you cannot do this, do steps one through four below.

Activity:

1. Give the photographs to the teacher assistant.
2. As the teacher assistant shows you each photograph, state the name and a use for the tool in the picture.
3. If you are correct, the teacher assistant will tell you. If you are not correct, he will tell you the name and a use for the tool in the picture.
4. Repeat steps 2 and 3 until you can name each tool and state a use for it also.

Post-test:

You will now become the teacher assistant. Locate a fellow student who wants to do this package. Help him to learn the names of each of these tools. Also help him to learn what they are used for. When he can do these tasks, have the first teacher assistant check him out.

HAND TOOLS - SIMPLE MACHINES

VERBAL IDENTIFICATION: AUGER BIT, SPEED BORE BIT, STRAIGHT SHANK DRILL, TAPER SHANK DRILL, COUNTER BORE, EXPANSION BIT, AND COMPOUND BIT.

Objective:

Given a package containing a picture of each of the following tools; an auger bit, speed bore bit, straight shank drill, taper shank drill, counter bore, expansion bit, and compound bit, and a teacher assistant who knows the name and use of each tool, you will state the correct name and use of each tool as he shows you its picture.

Pretest:

Tell the teacher assistant the correct name and use for each tool which he shows you a picture of.

Activity:

1. Give the package of pictures to the teacher assistant.
2. As the teacher assistant shows you each picture, tell him the correct name and a use of the tool in that picture.
3. If your answer is correct, the teacher assistant will tell you. If your answer is wrong, the teacher assistant will tell you the correct name and use of the tool.
4. Repeat steps 2 and 3 until you can tell the teacher assistant the correct name and use for each tool.

Post-test:

State to the teacher assistant the correct name and use for each tool which he shows you a picture of.

FOR THE STUDENT

No. I-220

HAND TOOLS - SIMPLE MACHINES

TYPES OF SOLDER: ACID CORE, ROSIN CORE AND LEAD-TIN

Objective:

Given written facts telling about the three types of solder and the conditions or tasks each type is used for, you will state to the teacher assistant the names of each type of solder and one use for each specific type.

Pretest:

State to the teacher assistant the name of each type of solder. Also tell him a use for each of the different types of solder.

Activity:

Solder is made by mixing two metals together. These two metals are lead and tin. If it has an equal or the same amount of lead and tin, it is called 50-50 solder, describing the percentage of each metal. Solder that has three times as much lead as tin is called 75-25 solder. This type of plain solder is used with a flux to join two pieces of metal together.

Rosin core and acid core solder looks like a wire with an opening in the middle. You might think that it looks like a small garden hose or a strand of spaghetti. The inside of this wire contains the flux. If the inside, called the core, has a rosin flux we call the solder rosin core solder. If the core contains an acid flux, we call the solder acid core solder. With both of these solders, we do not use any other flux.

Rosin core solder is used to join metals together when the metal is used to conduct electricity. The wires in your house, toys, radios and televions are examples of this. If we used the acid core solder, the acid would, during a long period of time, destroy the wires.

Acid core solder is used to join all metals together that are not used to conduct electricity. The advantage of using acid core solder instead of plain lead-tin solder is that it already has a flux, so we don't have to first apply the flux before the solder.

Post-test:

State to the teaching assistant the name and a use of each type of solder. Explain why each type is used for that type of task, by telling him the things that each solder is made of.

FOR THE STUDENT

No. I-222

HAND TOOLS - SIMPLE MACHINES

REMOVING A ROUGH EDGE FROM METAL BY GRINDING AND/OR WHETTING

Objective:

Given a machine grinder, whetting stone, a small cup of water and a flat chisel or gouge, you will sharpen the tool so that no burrs or nicks remain on the knife edge of that tool.

Pretest:

Given a dull chisel or gouge, a machine grinder, whetting stone and a small cup of water, sharpen the tool.

Activity:

Review the following 8mm loop films.

Title	Unit
SHARPENING THE CHISEL: GRINDING	Basic Woodworking
SHARPENING THE CHISEL: WHETTING	Basic Woodworking
SHARPENING THE GOUGE: GRINDING	Basic Woorworking
SHARPENING THE GOUGE: WHETTING	Basic Woodworking

Available from:

D.C. Heath and Co.
A Division of Raytheon Education Co.
2700 North Richardt Avenue
Indianapolis, Indianna 46219

Post-test:

Under the supervision of the teacher assistant, demonstrate the steps you will take to perform the above task. MAKE SURE THAT THE MACHINE GRINDER IS OFF. If at this time, the teacher assistant tells you that you are doing it properly, do each task. NOW YOU CAN TURN THE MACHINE GRINDER ON.

HAND TOOLS - SIMPLE MACHINES

CRITERIA FOR THE SELECTION OF SCREWDRIVERS

Objective:

Given a selection of several types and sizes of screws, and an assortment of several sizes of philips and slotted head screwdrivers, you will match the correct screwdriver with the corresponding screws.

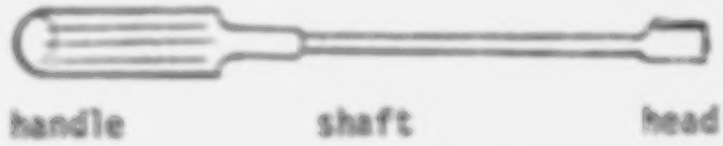
Pretest:

From the given assortment of screws and screwdrivers, match the correct screwdriver with the corresponding screws.

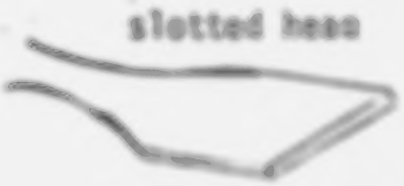
Activity:

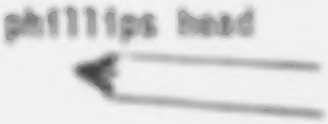
Read the information below. Look at the pictures below each group of sentences. The picture relates to the sentences above it. After you read each group of sentences, and after you have looked at the picture, take a screwdriver and a screw and duplicate the picture.

A screwdriver is used to turn a screw. It has a handle, a shaft, and a head. You hold the handle in your hand.

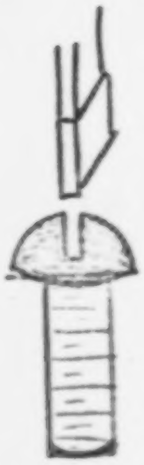


The head of the screwdriver, that part that fits into the slot in the screw, are of many designs. The most common design or type is the slotted head and the phillips head.

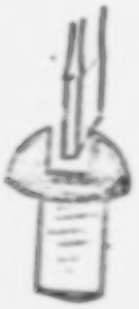




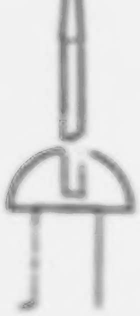
A slotted screwdriver has two faces which are flat. The slotted screwdriver is made to fit into the straight slot which is in the head of the screw.



If the slot is wider than the screwdriver, then you will be able to twist the blade or head of the screwdriver without turning the screw. This is very dangerous because the screwdriver will slip out of the slot and destroy the screw head. It can also slip and cut your hand.



The proper size screwdriver for a particular size screw must (1) fit into the slot in the screw head without being able to be twisted, and (2), must be as wide as the screw head so that the screwdriver is not damaged.



These same rules apply to the selection of a phillip head screwdriver. Select one that fit into the grooves in the screw hed. The grooves in the head of the phillips head screwdriver should notbe seen when placed in the grooves in the screw head.

Post-test:

From the given assortment of screws and screwdrivers match the correct size and type of screwdriver with each screw.

FOR THE STUDENT

No. I-225

HAND TOOLS - SIMPLE MACHINES

JOINING MATERIALS TOGETHER WITH MECHANICAL FASTENERS

Objective:

Given a length of board with two loose and two tightly secured wood screws (one loose and one tight screw are straight slotted, the other two are phillips head design), you will, under the supervision of the teacher assistant, properly tighten the loose screws and properly remove the two other screws from the board. For each task, you will select the proper screwdriver and state its correct name.

Pretest:

Given two loose and two tightly secured wood screws, and a selection of screwdrivers, select the correct screwdriver for the design of the screw, tell the teacher assistant its name, and remove the tightened screws and tighten the loose ones.

Activity:

Review the following 8mm loop film:

No.	Title	Unit
002/55	THE SCREWDRIVER	Basic Woodworking

Available from: D.C. Heath and Co.
A Division of Raytheon Education Co.
2700 North Richardt Avenue
Indianapolis, Indianna 46219

Post-test:

Tell the teacher assistant that you can fufill this objective. With the teacher assistant watching you, do the above tasks as they are asked in the objective. Be sure to tell the teacher assistant the name of each tool as you use it.

FOR THE STUDENT

No. I-230

HAND TOOLS - SIMPLE MACHINES

VERBAL IDENTIFICATION AND APPLICATION: ELECTRIC SOLDERING GUN, ELECTRIC SOLDERING COPPER (IRON), SOLDERING COPPER, AND PROPANE TORCH WITH SOLDERING TIP.

Objective:

Given a FILL-IN TYPE test, you will correctly answer all questions about choosing the right soldering tool for a special type of job.

Pretest:

Fill in the blank spaces with the name of the correct soldering tool which should be used in each job.

1. An ______________________________ should be used to solder the wires in a radio or television set together or to their connections.

2. A ______________________________ is heated in a fire before it can be used.

3. A ____ can be used anywhere because it has its own fire to heat it.

4. An ______________________________ is used to join to pieces of metal together, such as the corners of a small metal box.

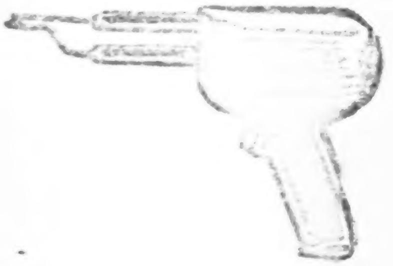
5. A small ____________________________________ is used where too much heat will destroy part of or the entire object being built or repaired, such as transistor radios.

6. A ________________________ without its soldering tip is used to heat pipes and other big things before we solder them together.

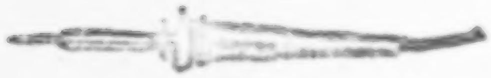
Activity:

Read the sentences below and look at the picture below each. The words tell you about each tool, the picture below the words is of that tool you are reading about. When you know the name and uses of each tool, take the post-test.

This is an electric soldering gun. The switch to turn it on and off is in the handle. The switch is shaped liked the trigger of a toy gun. Pressing the trigger with your finger turns it on. Taking your finger off of the trigger turns it off. This type of soldering tool, the electric soldering gun, is used to solder wires together or to their connections. They are used on radios and televisions, but cannot be used on transistor radios because they give off too much heat.

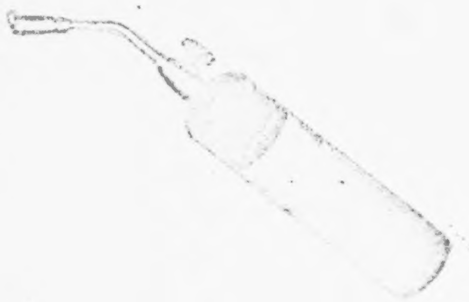


These two tools are both electric soldering coppers. Because the ends or tips of them are made of iron, some people call them electric soldering irons. Either name is right.The smaller one gives off a much smaller amount of heat than the big one. That's the reason why the smaller one is used to repair transistor radios. The bigger one, because it gives off much more heat, is used to solder pieces of metal together and sometimes to solder house wires together. Both of these electric soldering coppers have no on/off switch. Instead, they are turned on as soon as they are plugged in. BE CAREFUL, THEY ARE ALWAYS HOT WHEN PLUGGED IN.

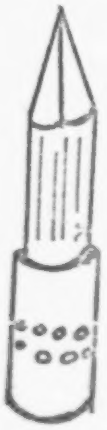


This is a soldering copper. It must be heated in a fire to get hot. It is called a soldering copper because it is made of a piece of copper on a metal rod. The rod is held in a wooden handle which is the part you hold. This tool is used to solder metal together when each piece of metal is very large, or when there is no electricity to heat an electric sodering copper, such as on top of a house roof. or in a field.

This is a propane torch. The top half, called the head, is screwed onto a metal bottle of propane gas. When the head is turned on, it allows the gas to leave the bottle through the head of torch, the same way that an open faucet lets waters run into the garden hose. We can light the gas with a match. If we do this, the gas will burn the same way that it does in your gas range at home.



We can use the heat (fire) of the torch to heat large pipes and other metal objects before we solder them together. For small pieces of metal, such as metal cabinets, we can attach a soldering copper to the head of the torch. This soldering copper is made just to fit this torch. It is heated in the flame. and gets very hot.



Post-test:

After each group of sentences, write the name of the soldering tool that is described. If you don't get all the answers right, repeat the ACTIVITY section of this package.

1. This soldering tool can be used on a rooftop or in a field to repair large metal objects because it carries its own source of heat. It is called a ____________________
2. This soldering tool has its own on/off switch and is used to solder wires together. It is called a ________________
3. This soldering tool gives off a small amount of heat. That is why it is used to fix broken transistor radios. It is called a ____________________
4. This soldering tool must be heated in a fire. It is called a ____________________

5. This tool is used to heat metal objects. It can also be used to solder wires. It is big and uses electricity. It is called a ____________________

6. This soldering tool can be used with or without its tip. It is called a ____________________

7. This soldering tool gets hot as soon as it is plugged in. It is called a ____________________.

TEACHER REFERENCE SHEET FOR PACKAGE No. I-230

Pretest:

Below are the correct responses to six pretest questions;

1. electric soldering gun
2. soldering copper
3. propane torch with soldering tip
4. electric soldering copper (iron)
5. electric soldering copper (iron)
6. propane torch

Post-test:

Below are the correct responses to the seven post-test questions;

1. propane torch
2. electric soldering gun
3. electric soldering copper (iron)
4. soldering copper
5. elctric soldering copper (iron)
6. propane torch with soldering tip
7. electric soldering copper (iron)

HAND TOOLS - SIMPLE MACHINES

SOLDERING: APPLYING THE PRINCIPLE OF THE HEAT SINK

Objective:

Given a long nose plier, a length of rosin core solder, a heat sink, a hot electric soldering copper, a transistor, a diode, a resistor, and a terminal strip, you will solder the components to the terminal strip without damaging them by overheating.

Pretest:

Given a hot electric soldering copper, a long nose plier, a length of rosin core solder, a diode, a transistor, and a resistor, and a terminal strip, demonstrate to the teacher assistant the use of the heat sink principle.

Activity:

Before you begin to read the information below, go to the tool locker and get the following tools:

1 cold electric soldering copper
1 long nose plier

Now, go to the materials locker and get the following materials:

1 10 inch length of rosin core solder
1 transistor, any number
1 resistor, any size
1 diode, any number
1 terminal strip, atleast six terminals.

YOU ARE NOW READY TO BEGIN. As you read each instruction, try to follow it with the tools and materials which you have in front of you. If you have any questions, read all the instructions first. If you still don't understand, ask the teacher assistant to help you.

STEP 1 Electric soldering coppers get very hot. They get hot enough that they can burn you. Electrical components, when placed near a hot electric soldering tool get very hot too. If they get too hot, they will be destroyed and will not work. To stop this from happening, we use a heat sink. If we do not have a heat sink, we use the principle upom which a heat sink works.

STEP 2 Heat always moves from a hot place to a cold place. That is why the heat from the fire of your mother's kitchen stove moves to the cold pot, and then to the cold food to heat it. If you can remember this, you can apply the principle of the heat sink to the task of soldering.

STEP 3 If we heat the end of a wire with a hot electric soldering tool, the heat will move or flow through the wire towards the other end. The amount of heat will vary at different points along the wire until all areas are the same temperature.

STEP 4 If we place an electrical component (a resistor, transistor, diode, etc.) between the two ends of the wire, it too will get hot. If it gets too hot, it will be ruined and will not work.

STEP 5 If we touch another piece of metal to the wire at a point between the electrical component and the hot soldering tool, half the heat will go to this second piece of metal and half will go to the component. This prevents the component from getting too hot.

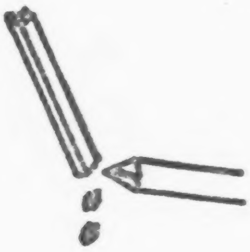
STEP 6 We apply this principle in soldering by holding the end of the wire attached to the component with the long nose plier. We solder the wire which we are holding with the long nose plier. This allows some of the heat to flow into the plier and not into the component, stopping the component from getting too hot.

STEP 7 Practice holding the component with the plier in one hand and the COLD electric soldering copper in the other. Make believe that you are soldering the part to the terminal strip. Try another different part.

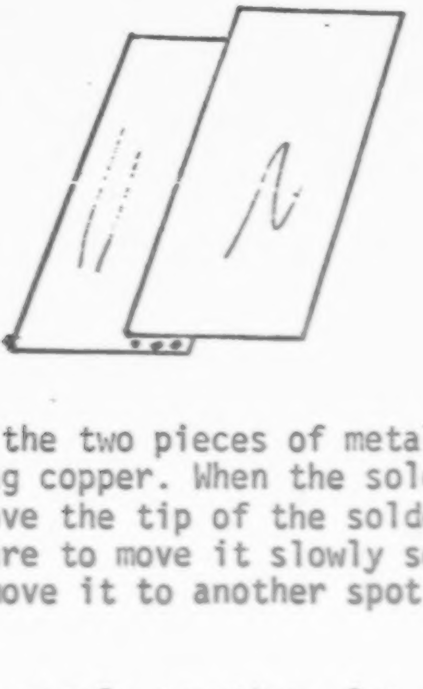
STEP 8 When you think that you can correctly do the pretest, ask the teacher assistant to watch you practice. When he is sure that you can do it correctly and safely, retake the pretest.

Using the small paint brush, apply the liquid flux to the two areas of the metal which you have just cleaned. The flux prevents an oxide, a rust-like coating,from forming which will not let the melted solder stick to the metal.

By touching the bar of solder with the tip of the hot soldering copper, you will melt the solder.into small balls. Using a pair of pliers, place these hot balls of solder onto the cleaned area of one of the pieces of metal. (See the picture below.)



Now place the metal with the solder on the asbestos tile. Place the surface or cleaned area of the other piece of metal on top of the first piece. The two pieces of metal should not look like a sandwhich, but they should rest on one another in the middle. (See picture below.)



Gently, touch the seam where the two pieces of metal rest on one another with the hot soldering copper. When the solder between the two pieces of metal melts, move the tip of the soldering copper slowly along the joint. Be sure to move it slowly so that the solder will melt before you move it to another spot.

After you have joined the two metals together, let them cool to room temperature. This should take about 10-15 minutes.

Place the cool joined metal pieces in a metal vise and bend them with a pair of pliers. If the joint does not come apart, you have done the job well. If it does come apart, practice doing it again.

Post-test:

Tell the teacher assistant the steps that you did to solder two piece of metal together, making sure to explain why you used a flux and how you protected yourslef from being burned.

(15)

FOR THE STUDENT

No. I-235

HAND TOOLS - SIMPLE MACHINES

JOINING: SOLDERING TWO WIRES TOGETHER

Objective:

Given an electric soldering gun, a two inch strip of rosin core solder, an asbestos tile, and two pieces of stripped bell wire, you will solder the two stripped ends of the wires together so that you will not be able to pull them apart.

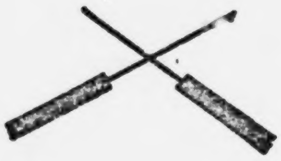
Pretest:

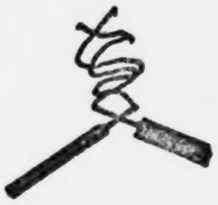
Given the necessary tools and materials, join two pieces of wire together by soldering so that you will not be able to pull them apart.

Activity:

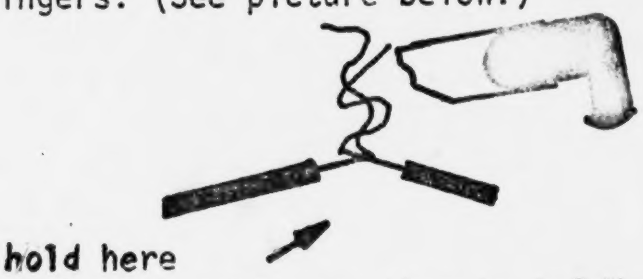
Look at the drawings below and read the descriptions next to each one. When you have read each one and you know the steps in soldering two wires together, take the post-test.

Hold the two wires so that they cross one another. Then, with a pair of lineman pliers, twist the two wires together as shown in the picture below.



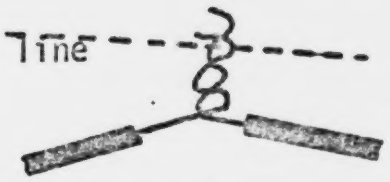


Apply heat to this twisted joint by touching the wires with the hot tip of the electric soldering gun, Be sure to hold the base of the twisted wires (near the covering) with a pair of pliers so you won't burn your fingers. (See picture below.)



When the wires are hot, apply the solder to them by holding it against the wire and the tip of the hot electric soldering gun. Slowly move the tip of the electric soldering gun up and down the joint to evenly heat the wires and apply the melted solder to them.

Allow the joint to cool to room temperature. Now, trim the sharp twisted ends of the two wires b y cutting off the tips with a pair of diagonal cutting pliers or a wire cutter. (See picture below.)



trim along dotted line

Holding one end of each of the two wires in a hand, pull at the two wires to see if the joint comes apart. If it didnot come apart, you have done the job right. If they did come apart, repeat this activity.

Post-test:

In your own words, state the several steps you did to properly solder two wires together to the teacher assistant.

FOR THE STUDENT

No. I-238

HAND TOOLS - SIMPLE MACHINES

IDENTIFICATION AND APPLICATION: SIDE CUTTING PLIERS, SLIP-JOINT PLIERS, LINEMAN PLIERS, AND LONG NOSE PLIERS.

Objective:

Given the tasks listed below, you will select from an assortment of pliers the proper pair of pliers for that particular task. You will then tell the teacher assistant the name of that tool which you have selected and perform that task in a safe manner while the teacher assistant watches.

1. Tighten a loose square-head wood screw into a block of wood.
2. Given a piece of iron wire, you will cut it in half.
3. Given a stripped piece of bell wire, you will form a hook on the stripped end so that it can be attached to a bolt.
4. Hold a nut in place while a screw is being tighted into it.
5. Given two pieces of wire, you will twist them together at one end and trim the twisted portion.

Activity:

Review the following 8mm loop film:

No.	Title	Unit
002/49	PLIERS IN WOODWORKING	Basic Woodworking

Available from: D.C. Heath and Co.
A Division of Raytheon Education Co.
2700 North Richardt Avenue
Indianapolis, Indianna 46219

Post-test:

Tell the teacher assistant that you can fufill this objective. With the teacher assistant watching you, do task 1 - 7 of the objective above, making sure that you tell him the name of the tool you will use for each task.

FOR THE STUDENT

No. I-240

HAND TOOLS - SIMPLE MACHINES

USE OF CLAMPING AND HOLDING DEVICES

Objective:

Given a woodworkers vise, machinists vise, C clamp, bar clamp and parallel or hand screw clamp, two pieces of stock, you will clamp or secure in position the stock so it will;

1. Not be damaged by the jaws or faces of the holding device.
2. Not move when it is being cut in half

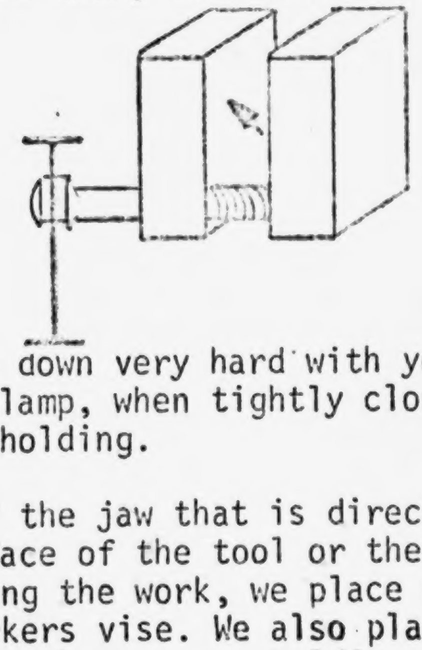
Prerequisite:

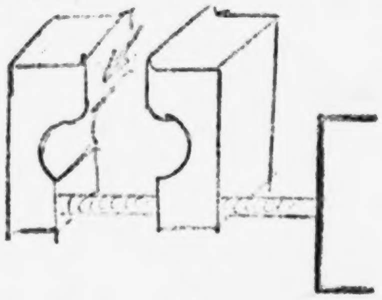
It would help to do packages I-211 and I-212 first.

Activity:

Read the information below. Look at the pictures that are below each paragraph. When you know the information needed to do the task above, have the teacher assistant watch you do each task.

All holding devices have jaws. These jaws are very much like your jaws in your mouth. If you put a straw between your top and lower jaw and close them, the straw will be held in place.





If you bite down very hard with your jaws, you will crush the straw. A vise or clamp, when tightly closed, will also dent or damage the work it is holding.

The part of the jaw that is directly against the work is referred to as the face of the tool or the face of the jaw. To stop the face from damaging the work, we place a block of wood on each face of the woodworkers vise. We also place a block of wood on each face of a C clamp when we are holding a piece of wood in place. We do the same thing when we use a bar clamp.

Wooden hand screw clamps don't need wooden blocks because they are made of wood.

To protect soft metals from being damaged by the jaws of a machinists vise, we place a piece of metal between the jaw and the work.

All holding devices have a jaw that moves. This jaw is connected to a large screw with a handle on its end. To move the jaw, we turn the handle. This tighten or loosens the holding tool from the work.

Now, go to the film library and view these 8mm loop films listed below.

No.	Name	Unit
002/48	THE HANDSCREW	Basic Woodworking
002/46	THE WORKBENCH AND VISE	Basic Woodworking
002/47	THE C CLAMP AND BAR CLAMP	Basic Woodworking

These films are available from:
Walden Film Corporation
39 East 31 Street
New York, New York 10016

Post-test:

In front of the teacher assistant, perform these tasks with the tools and materials used in each task;

1. Clamp a piece of wood to a table top.
2. Secure a pipe in a metal vise.
3. Clamp two pieces of wood together with a hand screw clamp.
4. Clamp two pieces of metal together with a parallel clamp.
5. Secure a piece of wood in the jaws of the woorworkers vise.

Each piece of stock should not move when gently hit with a mallet.

FOR THE STUDENT

No. J-1

SOPHISTICATED MACHINES

LATHE NOMENCLATURE

Objective:

You will be able to name the five main parts of the engine lathe and their main uses.

Prerequsite:

None.

Activity:

The five main parts of the modern engine lathe are the headstock, tailstock, bed, carriage, and quick-change gear box, as shown in figure J-1.

HEADSTOCK. The headstock contains the driving mechanism, either pulleys or gears. Usually you can obtain eight or ten different speeds by shifting the gears or pulleys. The chuck is driven from the headstock.

TAILSTOCK. The tailstock is used to support the outer end of the stock. A center can be placed in the hole at the end of the tailstock which will fit into a drilled hole in your stock. Also drills, reamers, and other cutting tools can be placed in the tailstock.

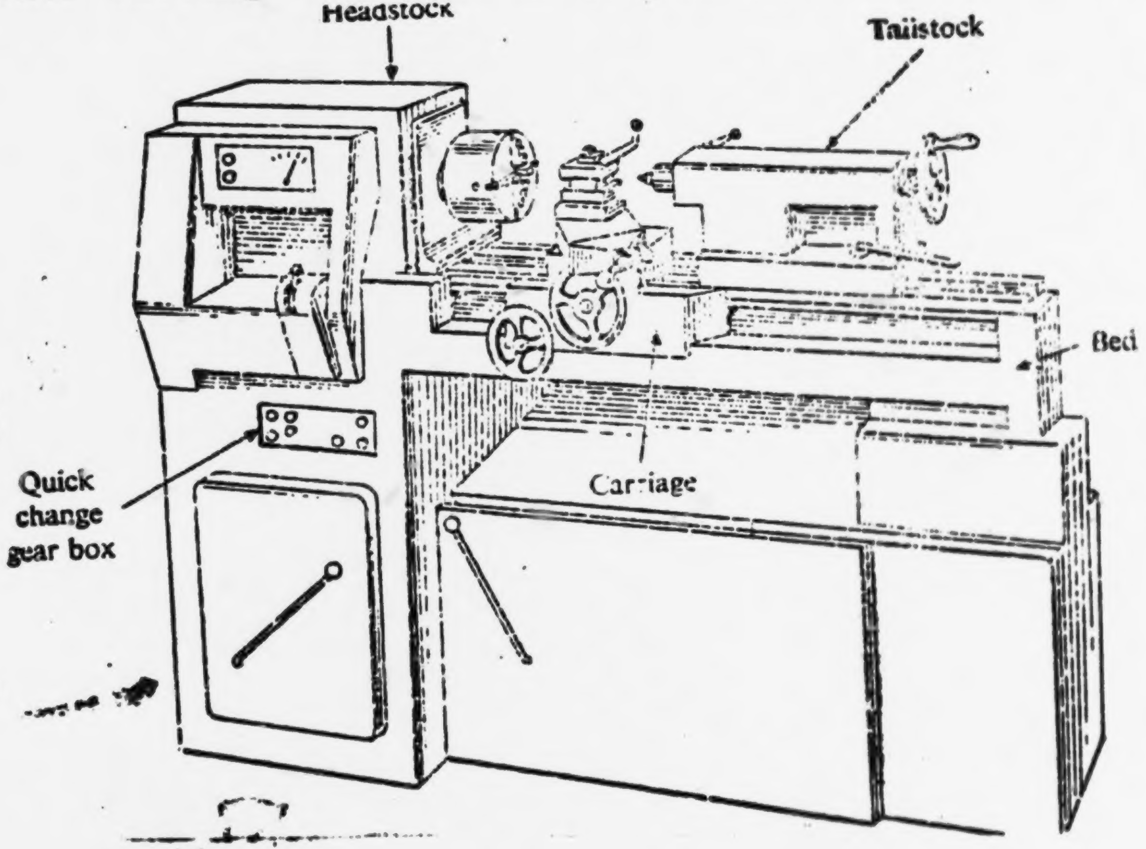


FIGURE J-1

BED. The bed is the basic part of the lathe. It is usually made of cast iron. At the top of the bed are the ways, which act as guides for the carriage and tailstock.
CARRIAGE. The carriage carries the cutting tool along the work. A cross-slide is mounted on top of the carriage which may be used to move the cutting tool in and out. Also, on top of the cross-slide is another cross-slide. This is refered to as the compound. It may be swiveled to cut different angles. The tool post is also mounted in the compound. The tool post holds the tool holder which, in turn, holds the cutting tool.
QUICK-CHANGE GEAR BOX. The quick-change gear box allows the operator to change the amount of feed quickly. Feed means how far the carriage or cross-slide feeds per revolution of the work.

**Study the main parts of the engine lathe which are listed. When you feel you know their names and their uses, go to the lathe in the shop and look it over and note where the parts are located. Then, take the Post Test.

POST TEST:

Directions: List the five main parts of the engine lathe and their uses.

1.

2.

3.

4.

5.

**When you have listed the five main parts of the engine lathe and their main uses, take your paper to the teacher and start on package J-2.

FOR THE STUDENT

No. J-2

SOPHISTICATED MACHINES

LATHE SAFETY PRECAUTIONS

Objective:

You will be able to pass the safety test on the engine lathe with a score of 100%.

You must have completed package J-1 before attempting this package.

Activity:

Directions: Go through the package and read the frames and fill in the blanks. If you miss a question, go back to the frame you are told, and try to answer the question again. Carefully follow the directions given at the end of each series of frames.

1. a. When operating a lathe, you should always wear safety glasses to protect your eyes.
   b. Safety glasses should be worn while operating the lathe to protect your ________.
   ** If you answered eyes, you are right. Go to frame 2a. If you did not answer eyes, go back to frame 1a.
2. a. You should never operate a lathe which does not have a guard over the gears.
   b. If you do not have a guard over the gears, you could get your arm or fingers caught and lose them!
   c. If a lathe does not have a guard over the gears tell the teacher before starting the lathe.
   d. Do not start a lathe that does not have a __________ over the gears.
   ** If you answered guard, you are right. Go to frame 3a. If you did not answer guard, go back to frame 2a.
3. a. You should never touch any moving parts on the lathe.
   b. If you touch any of the moving parts, you could get your fingers caught in them.
   c. You should __________ touch any moving parts of the lathe.
   ** If you answered never, you are right. Go to frame 4a. If you did not answer never, go back to frame 3a.
4. a. The tool bit used on the lathe should be on center of the stock.

b. If the tool bit is not on center of the stock, it may break and a flying particle may hit you.

c. If the tool bit used on the lathe is not on __________ it may break and a flying particle may hit you.
** If you answered center, you are right. Go to frame 5a. If you did not answer center, go back to frame 4a.

5. a. When a piece of stock is center drilled on both ends, you may turn it between centers.

b. Stock is turned between centers by fastening a lathe dog to the end of the stock, and putting the tail of the lathe dog in a faceplate, which is fastened to the headstock.

c. A center is placed in the tailstock and the center is placed in the end of the stock.

d. When a piece of stock is center drilled in both ends, you may turn it between __________.
** If you answered centers, you are right. Go to frame 5e. If you did not answer centers, go back to frame 5a.

e. Stock is turned between centers by fastening a lathe dog to the end of the stock, and putting the tail of the lathe dog in a __________ which is fastened to the headstock.
** If you answered faceplate, you are right. Go to frame 5f. If you did not answer faceplate, go back to frame 5b.

f. A center is placed in the __________ and the center is placed in the end of the stock.
** If you answered tailstock, you are right. Go to frame 6a. If you did not answer tailstock, go back to frame 5c.

6. a. The tailstock must be firmly clamped to the ways of the lathe.

b. If the tailstock is not firmly clamped to the ways, the stock could fly out and hit you.

c. The tailstock must be __________ clamped to the ways.
** If you answered firmly, you are right. Go to frame 7a. If you did not answer firmly, go back to frame 6a.

7. a. Chips that fall on the lathe must be removed with a brush.

b. If you remove the chips with your hands, you will cut yourself, because the chips are sharp.

c. Chips that fall on the lathe must be removed with a __________.
** If you answered brush, you are right. Go to frame 8a. If you did not answer brush, go back to frame 7a.

8. a. If any lever is jammed on a lathe, tell the teacher immediately.

b. If a lathe is started with a jammed gear or lever, the lathe may become seriously damaged.

c. If a gear or lever is jammed on the lathe, tell the______ immediately.
** if you answered teacher, you are right. Go to frame 9a. If you did not answer teacher, go to frame 8a.

9. a. Chuck jaws are tightened with a chuck key.
b. The square end of the chock key is inserted in the square slot of the chuck.
c. Never leave the chuck key in the chuck. It may fly out when you start the lathe and hit someone.
d. Never leave the chuck _______ in the chuck.
** If you answered key, you are right. Go to frame 10a. If you did not answer chuck, go back to frame 9a.

10. a. Gears on a lathe should never be shifted while the lathe is running.
b. If the gears are shifted while the lathe is running, the teeth on the gears may break.
c. The _______ on a lathe should never be shifted while the lathe is running.
** If you answered gears, you are right. Go to frame 11a. If you did not answer gears, go back to frame 10a.

11. a. While using a file on a lathe, you should hold the file in your left hand.
b. Guide the front of the file with your right hand.
c. You should hold the file in your left hand because you don't want your arms too close to the chuck.
d. When filing on the lathe, hold the file in your ________ hand.
** If you answered left, you are right. Go to frame 12a. If you did not answer file, go back to frame 11a.

12. a. When putting a heavy chuck on the lathe, use a block of wood to protect the ways.
b. Get a buddy to help you if the chuck is too heavy.
c. Always be careful not to drop the chuck on the lathe.
d. If you are lifting a heavy chuck, take caution not to drop the __________ on the machine.
** If you answered chuck, you are right. Go to frame 13a. If you did not answer chuck, go back to frame 12a.

13. a. When your work is all set up on the lathe, make sure all parts of the lathe turn freely.
b. You may do this by turning the dials and the chuck by hand.
c. If any dials cannot be turned, tell the teacher immediately.
d. When your work is all set up on the lathe, the next step is to be sure that all dials turn ___________.
** If you answered freely, you are right. Go to frame 14a. If you did not answer freely, go back to frame 13a.

14. a. While working on the lathe, keep your sleeves rolled up above the elbows.

b. If your sleeves are not rolled up above the elbows, they may get caught in the machine.

c. While running the lathe, keep your _________ rolled up above the elbows.

** If you answered sleeves, you are right. Go to frame 15a. If you did not answer sleeves, go back to frame 14a.

15. a. Studies have been made about accidents that happen on the lathe.

b. These studies show that most accidents happen because the person using the lathe was not working safely.

c. Safety rules must be enforced while working on the lathe.

d. Most accidents happen on the lathe because the operator was not working _________.

** If you answered safely, you are right. Go to frame 16a. If you did not answer safely, go back to frame 15a.

16. a. The safety zont around the lathe is outlined by a yellow line.

b. Only one person is allowed in the safety zone.

c. The safety zone around a lathe is outlined by a yellow line. Only _______ person is allowed in the safety zone.

** If you answered one, you are right. Go to frame 17a. If you did not answer one, go back to frame 16a.

17. a. Watches and other jewelry should not be worn while operating the lathe.

b. Jewelry could become caught in the machine.

c. _________ should never be worn while operating the lathe.

** If you answered jewelry, you are right. Go to frame 18a. If you did not answer jewelry, go back to frame 17a.

18. a. Ties, aprons, and other loose clothing should not be worn while operating the lathe.

b. They may become entangled in the moving parts of the lathe.

c. People have been killed because loose clothing has been caught in the machine.

d. You should __________ wear loose clothing while operating a lathe.

** If you answered never, you are right. Take the POST TEST. If you did not answer never, go back to frame 18a.

Directions: Take the entire test. Answer all questions. Only one answer is correct. Check the test with the answer sheet provided. If you missed a question go back to the frame listed on the answer sheet. Then, try to answer the question again. Remember, you must pass this test with a score of 100%. When you finish the test, take your paper to the teacher.

Circle the correct answer.

1. Safety glasses should be worn while operating the lathe to protect your __________.
   a. eyes
   b. ears
   c. face.
2. Do not start a lathe that does not have a ________ over the gears.
   a. safety zone
   b. guard
   c. headstock
3. You should _________ touch any moving parts of the lathe.
   a. sometimes
   b. always
   c. never
4. If the tool bit used on the lathe is not on ____________ it may break, and a flying particle may hit you.
   a. center
   b. top
   c. start
5. When a piece of stock is center drilled in both ends, you may turn it between ___________.
   a. centers
   b. chucks
   c. ends
6. Stock is turned between centers by fastening a lathe dog to the end of the stock, and putting the tail of the lathe dog in a _________ which is fastened to the headstock.
   a. headstock
   b. faceplate
   c. chuck
7. A center is placed in the _________ and the center is placed in the end of the stock.
   a. chuck
   b. tailstock
   c. lathe dog
8. The tailstock must be _______ clamped to the ways,
   a. lightly
   b. firmly
   c. loosely

9. Chips that fall on the lathe must be removed with a ________.
   a. rag
   b. brush
   c. file
10. If a gear or lever is jammed on the lathe, tell the ________ immediately.
   a. principal
   b. teacher
   c. tool foreman
11. Never leave the chuck ______ in the chuck.
   a. key
   b. slot
   c. center
12. The ________ on a lathe should never be shifted while the lathe is running.
   a. gears
   b. centers
   c. levers
13. When filing on the lathe, hold the file in your ________ hand.
   a. right
   b. near
   c. left
14. If you are lifting a heavy chuck, take caution not to drop the __________ on the lathe.
   a. chuck
   b. center
   c. headstock
15. When your work is all set up on the lathe, the next step is to be sure that all dials turn ___________.
   a. freely
   b. tight
   c. clockwise
16. While working on the lathe, keep your __________ rolled up above the elbows.
   a. shirt
   b. sleeves
   c. apron
17. Most accidents happen on the lathe because the operator was not working ___________.
   a. fast
   b. slow
   c. safely
18. Only _________ person is allowed in the safety zont.
   a. one
   b. two
   c. three
19. __________ should never be worn while operating the lathe.
   a. clothes
   b. jewelry
   c. glasses

20. You should _______ wear loose clothing while operating a lathe.
    - a. always
    - b. sometimes
    - c. never

***** Now check your answers with the answer sheet. If you miss a question, go to the frame mentioned. Then, try to answer the question again. When you have answered all questions correct, take your paper to the teacher.

ANSWER SHEET

1. Eyes. If you missed this question study frames 1a-b. Then answer the question again.
2. Guard. If you missed this question study frames 2a-d. Then answer the question again.
3. Never. If you missed this question, study frames 3a-c. Then answer the question again.
4. Center. If you missed this question study frames 4a-c. Then answer the question again.
5. Centers. If you missed this question study frames 5a-d. Then answer the question again.
6. Faceplate. If you missed this question study frames 5a-e. Then answer the question again.
7. Tailstock. If you missed this question study frames 5a-f. Then answer the question again.
8. Firmly. If you missed this question study frames 6a-c. Then answer the question again.
9. Brush. If you missed this question study frames 7a-c. Then answer the question again.
10. Teacher. If you missed this question study frames 8a-c. Then answer the question again.
11. Key. If you missed this question study frames 9a-d. Then answer the question again.
12. Gears. If you missed this question,study frames 10a-c. Then answer the question again.
13. Left. If you missed this question study frames 11a-d. Then answer the question again.
14. Chuck. If you missed this question study frames 12a-d. Then answer the question again.
15. Freely. If you missed this question study frames 13a-d. Then answer the question again.
16. Sleeves. If you missed this question study frames 14a-c. Then answer the question again.
17. Safely. If you missed this question study frames 15a-d. Then answer the question again.
18. One. If you missed this question study frames 16a-c. Then answer the question again.
19. Jewelry. If you missed this question study frames 17a-c. Then answer the question again.
20. Never. If you missed this question study frames 18a-d. Then answer the question again.

*****When you have obtained a score of 100%, go to your teacher. Then, start on package J-3.

FOR THE STUDENT

No. J-3

SOPHISTICATED MACHINES

BASIC LATHE OPERATION

Objective:

Given a bar of ½" diameter, by 6" long, cold rolled steel, you will turn the bar of stock to 3/8" ± 1/16".

Given the above bar of stock, you will face the stock to a length of 5-3/4" ± 1/8".

Prerequisite:

You must have completed packages J-1 and J-2 before attempting this package.

Activity:

Go to the slide library and get the tape numbered J 3. Also get the slide series numbered J 3. Make sure you have the lab sheet for the slide series. After you do this, set up the projector and tape recorder in the carrel. If you have any questions, see the shop foreman.

Follow the directions in the slide series.

Submit your completed work to the teacher or foreman for checking.

STUDENT LAB SHEET FOR SLIDE SERIES J 3

When the directions on the tape tell you to go to the lathe, note the number of the slide. Then look on this sheet for the corresponding slide number. When you perform the operations listed, check it off and return to the tape.

SLIDE NUMBER 2.

a. Tool holder
b. Facing tool
c. Turning tool
d. Scale
e. Chuck key
f. ½" dia. by 6" long, C.R.S.

SLIDE NUMBER 9.

a. Place stock in chuck
b. Leave 3" sticking out
c. Mark 2" from the end with a pencil

SLIDE NUMBER 10.

a. Tool holder in tool post
b. Tighten tool holder

SLIDE NUMBER 12.

a. Place facing tool in tool holder
b. Tighten facing tool in tool holder

SLIDE NUMBER 13.

a. Loosen tool holder
b. Right lever in third notch from left
c. Left lever in second hole from right

SLIDE NUMBER 15.

a. Push start button
b. Adjust lever to 250 RPM
c. Push stop button

SLIDE NUMBER 16.

a. Push start button
b. Move carriage handwheel in until tool touches stock
c. Push stop button

SLIDE NUMBER 17.

a. Move tool to side by turning cross-slide dial counterclockwise

STUDENT LAB SHEET CONT.

SLIDE NUMBER 21.

a. Push start button
b. Check lever above feed lever. Make sure it is down.
c. Push feed lever down
d. When tool is finished cutting, pull lever up
e. Push stop button

SLIDE NUMBER 23.

a. Remove facing
b. Insert turning tool
c. Be sure turning tool is tight

SLIDE NUMBER 24.
a. Tool is on center of stock
b. Tool holder is tight

SLIDE NUMBER 25.

a. Pull lever behind headstock down

SLIDE NUMBER 27.

a. Push start button
b. Move cross-slide dial in until tool touches work
c. Push stop button

SLIDE NUMBER 28.

a. Move carriage handwheel clockwise away from stock
b. Move cross-slide dial in .100.

SLIDE NUMBER 32.

a. Push start button
b. Push feed lever down
c. When stock feeds to line, pull feed lever up
d. Push stop button

TEACHER'S REFERENCE SHEET FOR STUDENT PACKAGE

DEMONSTRATION OUTLINE

I. Types of tool bits used on the lathe.

   A. Facing.
   B. Turning.

II. Tool holder.
   A. Inserting.
   B. Tightening.

III. Three jaw chuck.

   A. Tightening and loosening.

IV. Adjusting tool on center of stock.

   A. Demonstrate how rocker works to set tool on center.

V. Gear box.

   A. Show how to set for different feeds.

VI. Feed directional control levers.

   A. Show how to change feed reverse lever from one direction to another.
   B. Cross feed-carriage feed lever.
      1. Show students how to change from cross feed to carriage feed.

VII. Facing.

   A. Place stock in chuck.
   B. Put facing tool in tool holder.
   C. Place point of tool on center.
   D. Start machine.
   E. Adjust RPM's.
   F. Get touch.
   G. Move carriage handwheel in.
   H. Push feed lever down.
   I. Let tool feed across work.
   J. Stop feed by pulling lever.
   K. Stop machine.

VIII. Turning.

   A. Insert turning tool.
   B. Put point of tool on center.

C. Get touch.
D. Back carriage away.
E. Move cross slide dial in the desired amount.
F. Turn on feed.
G. Let tool feed along stock.
H. Turn feed off.
I. Shut machine off.

*note
If this basic demonstration is given after the student goes through the nomenclature and safety packages, he will gain more from it.

Media:

For this package the student will go to the study carrel and view the slide series on basic lathe operation. He must also have a bar of steel provided for his use. (½" dia. by 6" long). The following script is used in the slide series. It is recommended that you make your own slide series because of the wide varieties of lathes in use throughout the country. The lathe in this slide series is a Rockwell Delta.

SCRIPT FOR SLIDE SERIES

VISUAL	AUDIO
1. Focus	At the sound of the dot advance one frame on the projector. Your lab sheet tells you what to do on the machine for each frame that directs you to the machine.
2. Title Slide	This slide series describes basic lathe operation. Go to the tool crib and get the following tools: A facing tool, turning tool, tool holder,and a six inch scale. Also, go to the stock room and get a piece of ½ inch by 6 inches cold rolled steel. When you do this, check it off on your lab sheet. Shut off the projector. Shut off the tape and return here when you do the things stated on the lab sheet.
3. Safety rules.	You should be on slide number 3. Study these rules. You must obey these rules at all times.
4. Operator dressed safely.	This man is dressed safely. Are you? He has on no loose clothing, no jewelry, and his sleeves are rolled above the elbows.
5. Machine with parts labeled.	The parts labeled are the basic parts of the lathe.
6. Same at 5.	Pictured are other components of the lathe.
7. Chuck key.	This tool is placed in the square slot of the chuck. It enables you to tighten or loosen the chuck.
8. Tool bits and holder.	The facing tool is used to make the bar of stock smaller in length. The turning tool is used to make the bar of stock smaller in diameter. The tool holder is used to hold the tool bits.
9. Placing the stock in the chuck.	Go to the lathe and place the stock in the chuck as shown. Mark two inches from the end of the stock with a pencil. Do not cut past this line. When you do this, return to the tape. Shut off projector. Shut off tape.

VISUAL	AUDIO
10. Tool holder in tool post.	You should be on slide number 10. Take the tool holder and place it in the tool post. Tighten the tool post with the wrench as shown. Do this and return to the tape. Shut off the projector. Shut off the tape.
11. Tool bit in tool holder.	You should be on slide number 11. Place the facing tool in the tool holder. Tighten it. Do this and return to the tape. Shut off projector. Shut off tape.
12. Tool on center.	You should be on slide number 12. Study the picture. Go to the lathe and put the point of the tool bit on the center of the stock. Make sure your set up looks just like the picture. Do this and return to the tape. Shut off projector. Shut off tape.
13. Adjusting feed.	You should be on slide number 13. Study the picture and go to the lathe and set the gear box exactly as shown. It is set to feed .004". Be sure the machine is set for carriage feed. Do this and return to the tape. Shut off projector. Shut off tape.
14. Start machine.	You should be on slide number 14.
15. Adjusting speed.	While the machine is running, this is how the speed is adjusted. Go to the lathe and push the start button. Take the RPM adjustment handle and move it until it is set at 250 RPM. Then stop the lathe by pushing the red button and return to the tape. Shut off projector. Shut off tape.
16. Getting touch.	You should be on slide number 16. While the machine is running, move the carriage handwheel up to the end of the stock. When the tool touches the end of the stock a chip will form at the point of the tool bit. When this happens, shut the machine off by pushing the red button. This is called getting a touch.

VISUAL	AUDIO
Slide number 16 cont.	Go the your lathe and get a touch, then return to the tape. Shut off the projector. Shut off tape.
17. Tool moved in and ready to cut.	You should be on slide number 17. The tool is moved to the side after you get a touch by moving the cross slide handle counterclockwise. When the tool is moved away from the stock, move the carriage handwhee counterclockwise about a quarter of a turn. Do this and return to the tape. Shut off projector. Shut off tape.
18. Feed start.	You should be on slide number 18. To start feeding, turn the machine and push the carriage feed handle down. Make sure the feed control lever is set for cross feed.
19. Tool feeding in.	Then the tool will feed in.
20. Stopping feed.	Pull the feed handle up when the tool is finished cutting. Then push the stop button.
21. Finished job.	Your stock should look like this when you are finished. Go to the lathe and start it. Then push the feed lever and let the tool feed across the stock. Then push the stop button. When you do this return to the tape. Shut off the projector. Shut off the tape.
22. Inserting the turning tool.	You should be on slide number 22. Now go to your lathe and remove the facing tool and insert the turning tool. Return to the tape when you are finished. Shut off projector. Shut off tape.
23. Tool tightened.	Make sure your turning tool is tight. You should be on slide number 23.
24. Tool on center.	Study th picture and put your tool in exactly the same position as shown. Return to the tape when you have done this. Shut off the projector. Shut off the tape.

	VISUAL	AUDIO
25.	Lever set for feeding across.	You should be on slide number 25. Go to your lathe and pull the carriage feed control lever down. Do this and return to the tape. Shut off the projector. Shut off the tape.
26.	Button pushed for starting.	You should be on slide number 26. Now we can start the machining.
27.	Getting touch.	Turn the cross slide handwheel in until the tool touches the work. Then shut off the machine and return to the tape. Shut off the projector. Shut off the tape.
28.	Moved in.	You should be on slide number 28. Move the carriage handwheel away from the stock. Then turn the cross slide handwheel in .100. Do this and return to the tape. Shut off the projector. Shut off the tape.
29.	Feed lever pushed.	You should be on slide number 29. Notice the carriage feed control lever is set for carriage feeding. Then start the machine and push the feed lever down.
30.	Machine feeding.	Let the machine feed to the line you drew with your pencil.
31.	Stopping feed.	Then stop the feed.
32.	Finished job.	Your stock should look like this when you are done. Now go to your lathe and start the machine and let it feed to the line, then shut it off. Return to the tape when you have finished. Shut off the projector. Shut off the tape.
33.	Another lathe.	You should be on slide number 33. Here is what another type of lathe looks like.
34.	Hammer head.	This is a product that can be made on the lathe.
35.	The End.	Now take your stock and check list to the teacher. Set the projector to focus and set the tape to Rewind.

No. J-4

FOR THE STUDENT

SOPHISTICATED MACHINES

CUTTING A TAPER

Objective:

You will be able to turn a 2 degree taper on a piece of ½" dia. x 3" long, C.R.S. by using the compound rest on an engine lathe.

Prerequsite:

You must have completed packages J-1, J-2, and J-3.

Activity:

1. Go to the stock room and get a piece of ½" dia. x 3" long C.R.S.
2. Go to the lathe and loosen both nuts on the compound rest. If you have any problems, see your foreman or your teacher.
3. Set the compound rest on 0 degrees. Then, move the compound rest one degree counter-clockwise, and tighten the two nust.
   a. You will cut a 2 degree taper because even though the rest is set on one degree, one degree is being cut on each side of the stock, thus, 2 degrees.
4. Mark 1½" from the end of the stock.
5. Insert the tool holder and tool bit just as you would for a turning operation.
   a. Be sure your tool bit is on center and the tool post is tight.
6. Get a touch.
7. Move the carriage handwheel so that the point of the tool bit is even with the end of the stock.
8. While cutting a taper with the compound rest, do not use any automatic feeds.
9. Move the cross-feed dial in .020".
10. Feed the tool along the stock by turning the compound rest dial.
11. Bring the point of the tool bit to the end of the stock from which you started by turning the compound rest dial the opposite way you were just turning it.
12. At no time while cutting a taper, do you move the carriage handwheel.

No. J-5

FOR THE STUDENT

SOPHISTICATED MACHINES

KNURLING

Objective:

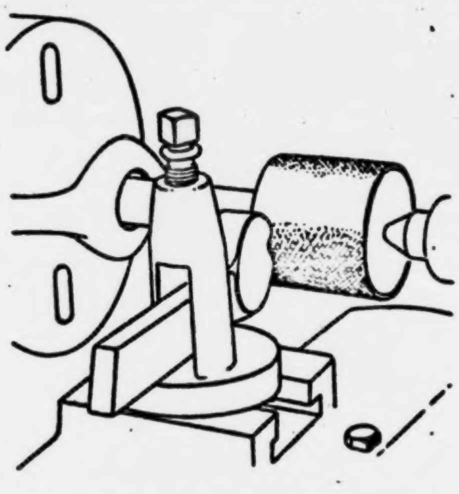
Given a piece of ½" dia. x 2" long C.R.S., you will be able to knurl the first 1" of the stock.

Prerequsite:

You must have completed packages J-1, J-2, and J-3.

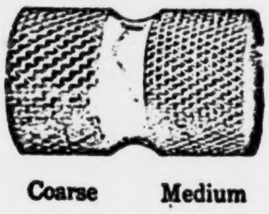
Activity:

1. Go to the tool room and get a knurling tool.
2. Go to the stockroom and get a piece of ½" dia. x 2" long, C.R.S.
3. Place the first 1" of the stock in a 3-jaw chuck.
4. Mark 1" from the end of the stock with a pencil.
5. Put the knurling tool in the tool post.
6. Center the knurling tool the same way you would center a tool holder and tool bit, only use the center of the rolls as the point of the tool bit.
7. Set the knurling tool perpindicular to the stock, as shown in the figure below.
8. Tighten the tool post.
9. Set the lathe at 100 RPM.
10. Start the lathe and move the knurling tool completely off the stock.
11. While knurling, never move the knurling tool completely off the stock.
12. Move the cross feed dial in .010".
13. Turn the carriage handwheel along the stock until the first 1" of the stock is knurled.
14. Move the tool back and forth, never moving it completely off the stock.



Knurling a steel piece in the lathe.

15. If the stock looks like the figure, stop the machine, remove the stock, and take it to the instructor.
16. If the stock does not look like the figure, move in another .005", and repeat the knurling process.
17. When you have finished, take the stock to the instructor.



Sample of knurling.

FOR THE STUDENT

SOPHISTICATED MACHINES

CENTER DRILLING

Objective:

Given a piece of ½" dia. by 1" long, C.R.S., you will be able to center drill the end of the stock.

Prerequsite:

You must have completed packages J1, J2, and J3.

Activity:

1. Go to the tool room and get a number 3 center drill and a lathe drill chuck.
2. Go to the stock room and get a piece of ½" dia. by 1" long C.R.S.
3. Place the drill chuck in the tailstock of the lathe.
4. Put the center drill in the drill chuck and tighten the chuck with the chuck key.
5. Put the stock in the lathe 3-jaw chuck, and tighten with the chuck key.
6. Center drilling speed is as fast as the machine will run.
7. Before any hole can be drilled in a piece of steel, it must be center drilled.
8. Start the machine.
9. Loosen the tailstock clamp and slide it along the lathe ways until the center drill is about 2" away from the end of the stock.
10. Tighten the tailstock clamp.
11. Turn the tailstock handwheel in until the center drill touches the end of the stock.
12. Move the tailstock handwheel in until the center drill is into the end of the stock as far as shown in figure J-3.
13. Stop the machine.
14. Start on package J-7 as soon as possible, as you must have this stock with the center drilled hole.

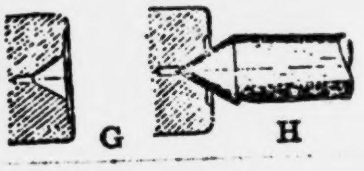


FIGURE J-3

FOR THE STUDENT

No. J-7

SOPHISTICATED MACHINES

TWIST DRILLING ON THE LATHE

Objective:

Given the center-drilled stock from package J-6, you will be able to drill a hole through the stock.

Prerequsite:

You must have completed packages J1, J2, J3, and J6.

Activity:

1. Be sure you have your stock from package J6.
2. Get a drill chuck and a ¼" drill from the tool room.
3. Put your stock in the lathe chuck with the center drilled end facing you.
4. Put the drill chuck in the tailstock.
5. Put the ¼" drill in the drill chuck and tighten it.
6. Set the lathe at 500 RPM.
7. Loosen the tailstock clamp and slide it along the ways until the end of the drill is about 1" from the end of the stock.
8. Start the machine.
9. Move the tailstock handwheel in until the drill touches the stock.
10. Put a few drops of oil on the drill.
11. Turn the handwheel in slowly about one full turn.
12. Move the drill out of the hole you are drilling by turning the tailstock handwheel counter-clockwise.
13. Clean the chips off the drill with a brush.
14. Move the drill back into the hole and repeat the above process until the drill is completely through the stock.
15. When you have finished, take your stock to the instructor.

FOR THE STUDENT

SOPHISTICATED MACHINES

SHAPER NOMENCLATURE

Objective:

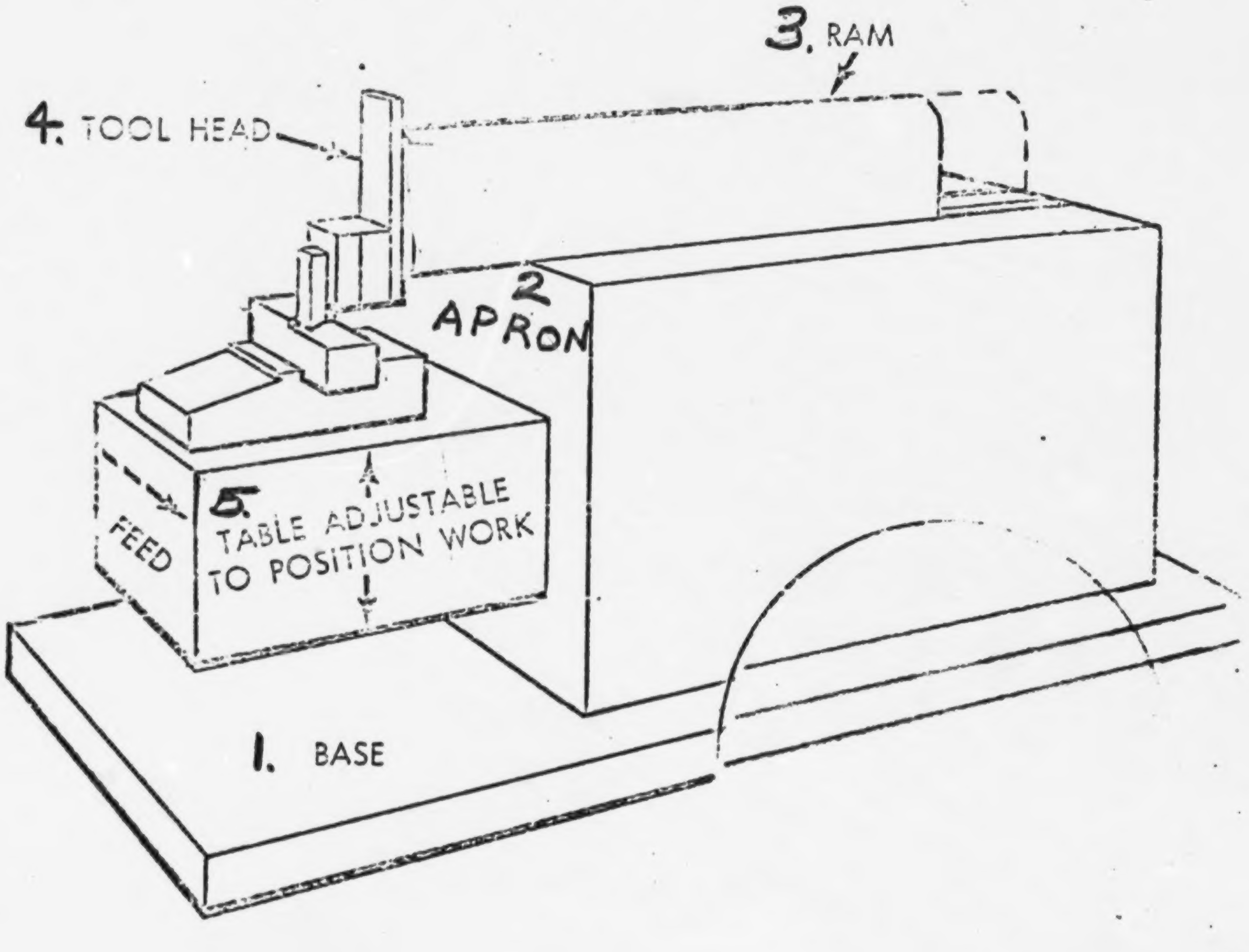
Given this instructional package, you will be able to list the five main parts of the shaper, and write the main use of each part.

Activity:

Read the following list of the main parts of the shaper. When you have finished, take the post test.

A shaper is made up of many parts. Each part is important to the operation of the machine. Five of the main parts shown in the figure are: 1. the base, 2. the apron, 3. the ram, 4. the tool head, and 5. the table.

1. The Base. The base is made of cast iron. All of the parts are mounted on the base. The inside of the base may be used for storing a supply of oil which is circulated to the moving parts of the shaper.



2. The Apron. The apron supports the table. The apron has a set of ways which allow the table to move from left to right.
3. The Ram. The ram is the main moving part of the shaper. It holds the cutting tool and drives it back and forth across the work.
4. The Toolhead. The toolhead is designed to hold the cutting tools. It is connected to the front of the ram. It may be moved to the left or right and locked in place.
5. The Table. The table is attached to the base of the shaper. It has slots on both sides which can be used for clamping the vice to the base. It may be adjusted and locked in position. The table is supported in front by a bracket attached to the base. The bolts connecting the bracket to the table must be loosened while the table is being moved.

When you know these five parts of the shaper, and the main uses of each one, take the Post Test.

POST TEST

Directions: Take this test. When you are finished, take your paper to the teacher.

List the five main parts of the shaper and the main use of each one.

1. ____________ ______________________

2. ____________ ______________________

3. ____________ ______________________

4. ____________ ______________________

5. ____________ ______________________

No. J-9

FOR THE STUDENT

SOPHISTICATED MACHINES

SHAPER SAFETY TEST

Objective:

Given this instructional package, you will be able to pass the safety test with a score of 100%.

Prerequsite:

You must have completed package J-8 before attempting this package.

Activity:

1. While using the shaper, you must wear safety glasses to protect your eyes.

2. Before making any adjustments on the shaper, be sure that the power is off.

3. Before starting the shaper, make sure that the toolhead will clear the work. Many broken toolheads have resulted from people who have not followed this rule.

4. Before turning on the power, make sure the ram clamp is tight. If the ram clamp is not tight, the stroke will change with the movement of the ram.

5. You should never shift the gears of a shaper while they are in motion.

6. Chips should be removed with a brush, and only when the machine is stopped.

7. While using the shaper, never wear jewelry.

8. You should never wear loose clothing around a shaper, it could get caught and you could get hurt.

9. Before starting the shaper, make sure all bolts are tight.

10. While using the shaper, you must wear safety glasses to protect your __________. If you answered eyes, go on to frame 11. If you did not, go back to frame one.

POST TEST.

1. While using the shaper, you must wear safety glasses to protect your:

   a. Eyes
   b. Ears
   c. Nose

* If you answered a, go to question 2. If you did not, go to frame 1 and read it. Then try this question again.

2. Before making any adjustments on the shaper, make sure the power is :

   a. On
   b. Off
   c. Running

* if you answered b, go to question 3. If you did not, go to frame 2 and read it. Then try this question again.

3. Before starting the shaper, make sure the toolhead will clear the :

   a. Ram
   b. Tool
   c. Work

* If you answered c, go to question 4. If you did not, go to frame 3 and read it. Then try this question again.

4. Before turning on the power, be suer the ram clamp is:

   a. Tight
   b. Loose.

* If you answered a, go to question5. If you did not, go to frame 4 and read it. Then try this question again.

5. You should never shift the gears of a shaper while they are in:

   a. Motion
   b. Reverse
   c. Stopped

* If you answered a, go to question 6. If you did not, go to frame 5 and read it. Then try this question again.

6. Chips should be removed with a brush while the shaper is:

   a. On
   b. Moving
   c. Off

* If you answered c, go to question7. If you did not, go to frame 6 and read it. Then try this question again.

7. While using the shaper, you should never wear:

   a. Jewelry
   b. Clothes
   c. Shoes

* If you answered a, go to question 8. If you did not, go to frame 7 and read it. Then try this question again.

8. You should never wear loose __________ around a shaper:

   a. Watches
   b. Clothing
   c. Hair

* If you answered b, go to question 9. If you did not, go to frame 8 and read it. Then try this question again.

9. Before starting a shaper, make sure all bolts are:

   a. Tight
   b. Loose
   c. Off

* If you answered a, take your paper to the teacher. If you did not, go to frame 9 and read it. Then try this question again.

11. Before making any adjustments on the shaper, make sure the power is ________. If you answered off, go on to frame 12. If you did not, go back to frame 2.

12. Before starting the shaper, make sure the toolhead will clear the ________. If you answered work, go on to frame 13. If you did not, go back to frame 3.

13. Before turning on the power, be sure the ram clamp is __________. If you answered tight, go on to frame 14. If you did not, go back to frame4.

14. You should never shift the gears of a shaper while they are in ____________. If you answered motion go on to frame 15. If you did not, go back to frame 5.

15. Chips should be removed with a brush while the shaper is ________. If you answered off, go on to frame 16. If you did not, go back to frame 6.

16. While using the shaper, you should never wear ________. If you answered jewelry, go on to frame 17. If you did not, go back to frame 7.

17. You should never wear loose _________ around a shaper. If you answered clothing, go on to frame 18. If you did not, go back to frame 8.

18. Before starting the shaper, make sure all bolts are __________. If you answered tight, take the Post Test. If you did not, go back to frame 9.

No. J-10

FOR THE STUDENT

SOPHISTICATED MACHINES

SPEEDS AND FEEDS USED ON THE SHAPER

Objective #1:

You will be able to compute the correct speed at which to set the shaper.

Objective #2:

You will be able to write the simple rule that is used in setting the shaper to feed across the work.

Prerequsite:

You must have completed packages J-8 and J-9 before attempting this package.

Activity:

1. As you further your study of machines, you will find that the operation and construction of sophisticated machines follow certain principles of mathematics. In this lesson, you will find that the speed at which you set your shaper is computed by using a simple math formula. This formula is: $N = \frac{\text{Cutting speed} \times 7}{\text{Length of work in inches}}$ N stands for

   the number of strokes per minute. 7 is a constant that always remains the same regardless of what type of material is being cut.
2. At this point, cutting speed should be explained. Cutting speed is simply the number of feet per minute a certain type of material should be cut. This means that a certain number of feet should pass the point of the tool bit in one minute. Since we can't set the machine to cut in feet per minute, we must use the formula above to compute the number of strokes per minute needed to do a good job.
3. A group of engineers computed a table which tells you at how many feet per minute certain materials should be cut.
   The table includes the following information:

TYPE OF MATERIAL TO BE CUT	FEET PER MINUTE
Cold Rolled Steel	100
Cast Iron	80

Tool Steel	50
Brass	150
Aluminum	500

4. Now, let's try a problem. We have a piece of cold rolled steel which is 5 inches long. At how many strokes per minute should we set the machine? Solution: Cold rolled steel has a cutting speed of 100 feet per minute, taken from the table. Our stock is 5 inches long. Using the formula: $N = \frac{CS \times 7}{L}$ we simply plug in the values which we know. $N = \frac{100 \times 7}{5} = \frac{700}{5} = 140$. We set the machine at 140 strokes per minute. Study the problem and try to work it yourself.
5. Now, let's try another problem. We have a 10 inch piece of cast iron. At how many strokes per minute should we we set the shaper? Solution: $N = \frac{CS \times 7}{L}$. We know the cutting speed of cast iron is 80 feet per minute from the table. We also know that our job is 10 inches long. Now, we just plug in what we know: $N = \frac{80 \times 7}{10} = \frac{560}{10} = 56$. We set the shaper to cut at 56 strokes per minute. If an answer does not come out even, for example if you computed 51.6 strokes per minute, round off to the nearest stroke.
6. If we had a piece of cold rolled steel that was 4 inches long, how many strokes per minute would you set the shaper to cut? If you did not get 175 strokes per minute, see your teacher for some help.
7. When taking a rough cut on the shaper, set the machine to feed at .020" per stroke. While taking a finish cut on a shaper, set the machine to feed .010" per stroke. This is a simple rule that some machinists use. If you remember it, it will save you time while you are working on the shaper.

POST TEST

1. How many strokes per minute should you set a machine that is cutting a piece of 10" cold rolled steel?

2. How many strokes per minute should you set a machine that is cutting a piece of 5" cast iron?

3. What feed is used when taking a roughing cut on a shaper?

4. What feed is used for taking a finish cut on a shaper?

*** If you did not get 70 strokes per minute as an answer for question number 1, see the teacher.

***If you did not get 112 strokes per minute as an answer for question number 2, see the teacher.

***If you did not say .020" as an answer for question number 3, see the teacher.

***If you did not say .010" as an answer for question number 4, see the teacher.

FOR THE STUDENT

SOPHISTICATED MACHINES

MILLING MACHINE SAFETY

Objective:

You will be able to pass the safety test on the milling machine with a score of 100%.

Prerequsite:

You must have completed package J-13.

Activity:

1. While operating a milling machine, the operator must wear safety glasses.
2. You must not wear any loose clothing. The clothing could get caught in the machine and you could get seriously injured.
3. You must never wear jewelry while operating the milling machine.
4. Before operating a milling machine, you must have your sleeves rolled up above your elbows.
5. You should never change spindle speeds while the machine is in motion.
6. Before starting a milling machine, be sure the direction of spindle rotation is correct. (The cutter must turn in the opposite direction that the table is feeding.)
7. Never remove or tighten a milling machine arbor nut while the machine is on.
8. Keep your hands and arms away from revolving milling cutters.
9. Never reach over a revolving cutter to make any adjustments. You could get cut by the cutter or get caught in the spindle.
10. Never attempt to check the work while the cutter is rotating.
11. Chips should be removed from the milling machine table with a brush, while the power is off.
12. Once you have finished using the machine, you should release all automatic feeds you have engaged so the next person to run the machine will not have an accident that perhaps you caused!
13. You should remember that the milling machine, like all other toolroom machines can be dangerous if they are used improperly.

14. While operating a milling machine, the operator must wear __________ __________. If you answered safety glasses, you are right. Go on to frame 15. If you did not, go back to frame 1 and read it. Then try this question again.
15. You must not wear any __________ clothing around the milling machine. If you answered loose, go to frame 16. If you did not, go back and study frame 2. Then try this question again.
16. You must ____________ wear jewelry while operating the milling machine. If you answered never, go to frame 17. If you did not, study frame 3, and try this question again.
17. Before operating a milling machine, your sleeves should be rolled __________ the elbows. If you answered above, go to frame 18. If you did not, go back to frame 4 and study it. Then try this question again.
18. You should never change spindle speeds while the machine is ____________. If you answered running, go on to frame 19. If you did not, go back and study frame 5. Then, try this question again.
19. Before starting a milling machine, be sure the direction of spindle ___________ is correct. If you answered rotation, go on to frame 20. If you did not, go back and study frame 6. Then try this question again.
20. Never tighten a milling machine arbor while the machine is ________. If you answered on, go on to frame 21. If you did not, go back to frame 7 and study it. Then try this question again.
21. Keep your hands and arms away from revolving milling ____________. If you answered cutters, go on to frame 22. If you did not, go back to frame 8 and study it. Then try this question again.
22. Never reach over a revolving _____________ to make any adjustments. If you answered cutter go on to frame 23. If you did not, go back to frame 9 and study it. Then try this question again.
23. Never attempt to check work in the milling machine while the cutter is in _____________. If you answered motion go on to frame 24. If you did not, go back to frame 10 and study it. Then try this question again.
24. Chips should be removed from the milling machine table with a ____________ while the power is off. If you answered brush, go on to frame 25. If you did not, go back to frame 11 and study it. Then try this question again.
25. When you have finished using the milling machine, all automatic feeds should be ____________. If you answered off go on to frame26. If you did not, go back to frame 12 and study it. Then try this question again.

26. The milling machine, like all other toolroom machines can be dangerous if used ______________. If you answered improperly, take the post test. If you did not go back and sutdy frame 13. Then try this question again.

POST TEST

1. While operating the milling machine, you should wear ________ to protect your eyes.
   a. Safety Glasses
   b. Loose Clothing
   c. Jewelry

If you answered a, go on to question 2. If you did not, go study frame 1. Then try this question again.

2. You should never wear __________ clothing around the milling machine.
   a. loose
   b. tight
   c. green

If you answered a, go on to question 3. If you did not, go studyframe 2. Then try this question again.

3. You must never wear _________ around the milling machine.
   a. jewelry
   b. clothing
   c. safety glasses

If you answered a, go on to question 4. If you did not, go study frame 3. Then try this question again.

4. Before operating a milling machine, your sleeves should be rolled above the ___________.
   a. wrists
   b. elbows
   c. sholders

If you answered b, go on to question 5. If you did not, go study frame 4. Then try this question again.

5. You should never change spindle speeds while the machine is _______________.
   a. off
   b. feeding
   c. running

If you answered c, go on to question 6. If you did not, go study frame 5. Then try this question again.

6. Before starting a milling machine, be sure the direction of spindle ____________ is correct.
   a. rotation
   b. feed
   c. chatter

If you answered a, go on to question 7. If you did not, go study frame 6. Then try this question again.

7. Never tighten a milling machine arbor while the machine is in ___________.
   a. gear
   b. feed
   c. motion

If you answered c, go on to question 8. If you did not, go study frame 7. Then try this question again.

8. Keep your hands and arms away from revolving milling _________.
   a. machines
   b. arbors
   c. cutters

If you answered c, go on to question 9. If you did not, go study frame 8. Then try this question again.

9. Never reach over a revolving ____________ to make any adjustments.
    a. work
    b. cutter
    c. milling machine

If you answered b, go on to question 10. If you did not, go back to frame 9 and study it. Then try this question again.

10. Never attempt to check work in the milling machine while the cutter is in ____________.
    a. motion
    b. gear
    c. force.

If you answered a, go on to question 11. If you did not, go study frame 10. Then try this question again.

11. Chips should be removed with a __________ while the power is off.
    a. file
    b. rag
    c. brush

If you answered c, go on to question 12. If you did not, go study frame 11. Then try this question again.

12. When you have finished using the milling machine, all automatic feeds should be ____________
    a. on.
    b. off.
    c. engaged.

If you answered b, go on to question 13. If you did not, go back to frame 12 and study it. Then try this question again.

13. The milling machine, like all other toolroom machines can be dangerous if used ____________________.
    a. correctly
    b. properly
    c. improperly

If you answered c, take your test to the teacher, If you did not, study frame 13 and try to answer the question again.

TEACHER PACKAGE

SOPHISTICATED MACHINES

SHAPER DEMONSTRATION OUTLINE

Objective:

The student will view the shaper demonstration.

Prerequsite:

Packages J-8 and J-9.

Activity:

You should cover the following things in your demonstration:

- I. Safety.
  - A. No loose clothing, jewelry etc.
- II. Placing work in a vise.
  - A. Tightening with a rubber mallet.
- III. Adjusting toolhead.
  - A. Picking up work with tool bit.
  - B. Moving in desired amount.
    - 1. Go beyond amount to be removed and come back to setting to eliminate backlash.
- IV. Stroke Adjustment.
  - A. Length in inches.
  - B. Stroke position.
- V. Feed Adjustment.
  - A. .010 for finish cuts.
  - B. .020 for rough cuts.
- VI. Speed adjustment.
  - A. Have student figure stroke speed.
- VII. Start Machine.
  - A. Move close to work.
  - B. Set machine to feed.
  - C. Let machine feed across work.
- VIII. Stopping machine.
  - A. Shut off power.
  - B. Warn students about burrs on stock.
  - C. Remove Stock.
  - D. Clean up machine.

No. J-12

FOR THE STUDENT

SOPHISTICATED MACHINES

STUDENT LAB SHEET FOR SHAPER OPERATION

Objective:

You will be able to shape .050" off a piece of 1" X 2" X 4" C. R. S.

Prerequsite:

You must have completed packages J8, J9, J10, and watched the teacher's demonstration.

Activity:

1. Go to the stockroom and obtain a 1" X 2" X 4" piece of C. R. S.
2. Go to the toolroom and get a 6" scale and a rubber or lead hammer.
3. Place the stock in the shaper so that the 1" side of the stock is between the vice jaws.
4. Hammer the vice handle with the hammer until it is tight.
5. Be sure you are dressed safely and you are wearing eye protection.
6. Set the machine for a 5" stroke.
7. Position the ram so the entire stock will be cut, once the machine has been started.
8. Set the feed at .010" per stroke.
9. Set the speed for 100 strokes per minute.
10. Pick up the surface of the stock with the tool, as the teacher did in the demonstration.
11. Move the tool away from the stock.
12. Move down .050", just as the teacher did in the demonstration.
    Note* Go $\frac{1}{2}$ turn past .050 on the dial, then come back to .050 on the dial. This eliminates any backlash in the screw and may prevent an accident.
13. Lock the toolhead in position.
14. Be sure all bolts are tight and that nothing will interfere with the travel of the ram.
15. Start the machine.
16. Engage the feed lever.
17. Engage the ram clutch lever.

18. Let the machine feed across the entire stock.
19. Stop the machine when the tool is clear of the stock.
20. Shut the machine off.
21. File the burrs off the stock.
22. Take the stock and this lab sheet to the teacher.

18. Let the machine feed across the entire stock.
19. Stop the machine when the tool is clear of the stock.
20. Shut the machine off.
21. File the burrs off the stock.
22. Take the stock and this lab sheet to the teacher.

FOR THE STUDENT

SOPHISTICATED MACHINES

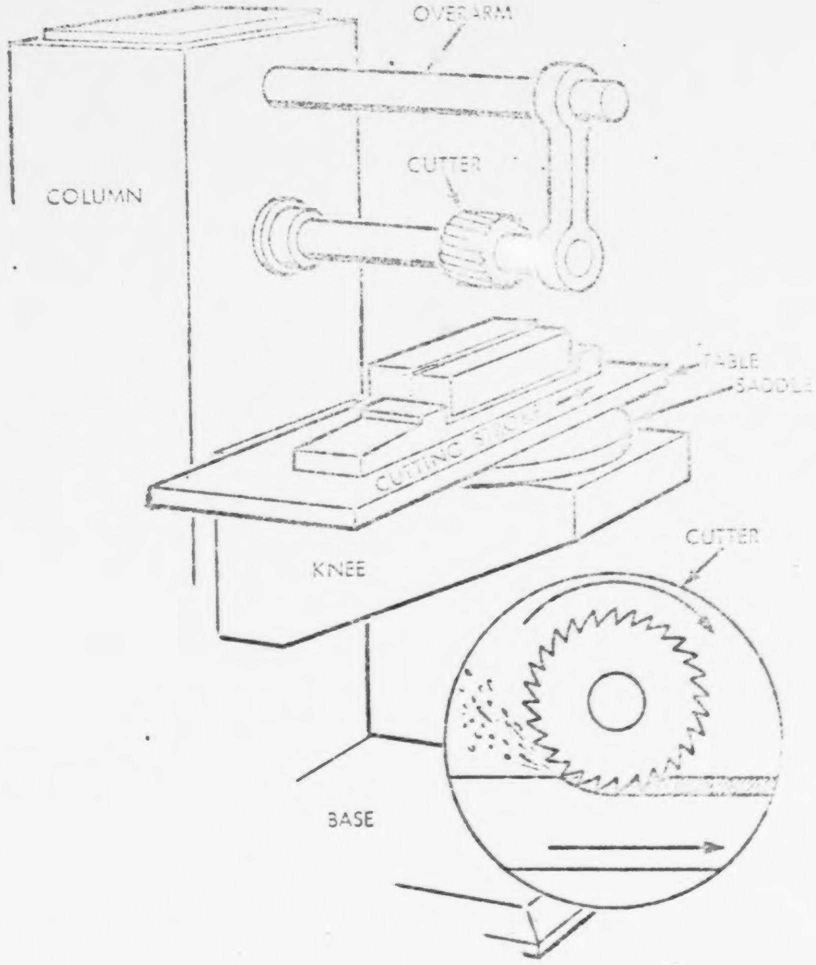
MILLING MACHINE NOMENCLATURE

Objective:

You will be able to list the 5 main parts of the milling machine and describe, in writing, their main uses.

Activity:

The five main parts of the milling machine shown in the diagram are: The column, The table, The saddle, The knee, and the base.


OVERARM
CUTTER
COLUMN
TABLE
SADDLE
CUTTING STROKE
KNEE
CUTTER
BASE

1. The column. The column is the main casting which supports all the other parts of the machine. The front of the column is machined to provide an accurate guide for the vertical travel of the knee.
2. The table. The table holds the workpiece. It rests on the guides of the saddle. T slots are machined along the length of the top surface of the table. They are used to align the job or the fixture which holds the job.
3. The saddle. The saddle supports the table. It is supported and guided by the knee.
4. The knee. The knee supports the saddle. The feed gears are enclosed in the knee. The knee can be raised or lowered on the column.
5. The base. The base supports the whole machine. Sometimes oil is stored in the base. This oil can be used to power the milling machine or it can be used as a coolant.

* Milling machines used in the toolroom are of the column and knee type. If the spindle is in a vertical postition, the milling machine is said to be vertical. If the spindle is in the horizontal position, the milling machine is said to be horizontal. If the table can be swiveled to a desired angle, it is said to be universal.. If the table can't be swiveled, it is said to be plain.

Thus, when you hear someone talk about a plain column and knee milling machine or a universial column and knee milling machine, you will know what he is talking about.

***Study the above information and the diagram and when you know the main parts of the milling machine and their main uses, take the post test.

POST TEST

Directions: List the five main parts of the milling machine and their main uses. When you have finished, take your paper to the teacher.

1. ________________. ______________________________

____

____

____

2. ________________. ______________________________

____

____

3. ____________________. __________________________

____

____

4. ______________________. ________________________

____

____

5. ____________________. __________________________

____

____

No. J-15

FOR THE STUDENT

SOPHISTICATED MACHINES

MILLING MACHINE CUTTERS

Objective:

Given the diagram of milling machine cutters, you will be able to name the 7 types of cutters used and how they are used properly.

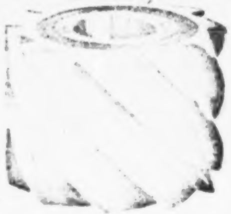
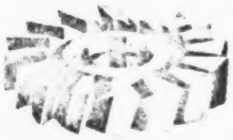
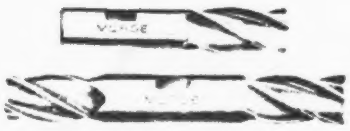
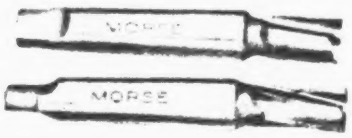
Prerequsite:

You must have completed packages J-13 and J-14.

Activity:

Study the diagram and proceed through this package.

SOME COMMON MILLING CUTTERS AND THEIR USES[a]

	Name	Picture	Use	Machine used on	
				Horizontal	Vertical
1.	Plain with helical teeth		For flat horizontal surfaces; to square up a block	X	
2.	Side with straight teeth		For light-duty side milling and slotting	X	
3.	Half side		For straddle milling	X	
4.	Slitting saw with plain teeth		For sawing and cutting narrow grooves	X	
5.	Straight-shank end mills with either single or double end		For all end milling, surface milling, and slotting	X	X
6.	Taper-shank end mills with two flutes or multiple flutes		For plunge cutting (like drilling), use a two-flute end mill	X	X
7.	Shell end mill		For milling larger surfaces—face and slab milling	X	X

Now that you have studied the types of cutters and their uses, try to list them. When you have finsihed, take your paper to the teacher.

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

6. ____________________

7. ____________________

FOR THE STUDENT

SOPHISTICATED MACHINES

FEEDS USED ON A MILLING MACHINE

Objective:

You will be able to compute the proper feed rate used on a milling machine to do a successful job.

Prerequsite:

You must have completed packages J-13, J-14, and J-15.

Activity:

1. Feed rates are computed by using a simple math formula. As you know, the feed rate of a milling machine is in inches per minute. The feed rate is independent of the speed of the spindle.
2. The rule to remember in computing the proper feed rate is that you should remove .001" of stock per tooth of cutter per revolution of the spindle.
3. That may sound complicated, but it is really easy.
4. Let's suppose we had a 4 tooth cutter running at 100 RPM. We will always know how many teeth the cutter has and how fast the machine is running. If we are to remove .001" per tooth and we have four teeth we should remove .004". And, if we are to remove .004" per revolution and we are running at 100 RPM, we just multiply .004"X 100RPM. We get .4". That means we should set our feed rate at about ½" per minute.
5. Lets state the rule again. *Count the number of teeth on the cutter and multiply it by .001. Then, multiply that number by the number of RPM's you have the machine set at. Isn't that simple?
6. Lets try another problem. Our machine has a 2 tooth cutter, and is running at 500 RPM. We just multiply 2 by .001 and get .002. Now we multiple .002 by 500, and we get 1. This means we set our machine at 1 inch per minute.
7. Remember the rule. It has only two steps. They are:
    1. Multiply the number of the teeth on the cutter by .001.
    2. Multiply the number you got in 1 by the number of RPM;s the machine is set at.
8. You will always be able to come up with an answer. This is how the engineers set the machinery in the factories to cut engine blocks, drill holes, and do all sorts of operations.

9. Let's try one more problem. Suppose we had a 6 tooth cutter running at 500 RPM. How fast would you set the feed? Before you go to number 10, try the problem and see if you get an answer.
10. The solution to this problem is easy. First, multiply the number of teeth by .001. We get .006. Then we just multiply .006 by 500 and get 3.0 We set our machine to feed at three inches per minute.
11. How fast would you set a 4 tooth cutter running at at 500 RPM's?
12. If you did not get two inches per minute for an answer, go to the teacher or the shop foreman for some help.
13. If you feel you understand this completely, take the post test.

POST TEST

1. How fast would you set a cutter with 2 teeth running at 500 RPM?

2. How fast would you set a 4 tooth cutter running at 200 RPM?

3. How fast would you set a cutter with 6 teeth running at 200 RPM?

.... If you did not get 1.0 for number 1, .8 for number 2, and 1.2 for number three, check your work. If you can't find where you went wrong, see the teacher.

FOR THE STUDENT

SOPHISTICATED MACHINES

SPEEDS USED ON A MILLING MACHINE

Objective:

You will be able to compute the correct speed needed to operate a milling machine cutter.

Prerequsite:

You must have completed packages J-13, J-14, and J-15.

Activity:

1. Remember that in package J-10, we used a formula to compute the speed at which a shaper should be set?
2. We use another formula which the engineers computed for use on the milling machine. This formula will give us the proper number of RPM's needed to operate a milling machine cutter.
3. The formula is $RPM = \frac{4 \times C}{D}$. 4 is a constant that always remains the same. C is the cutting speed of the material being cut. You remember that the cutting speed of cold rolled steel is 100 feet per minute, cast iron is 80 feet per minute, and aluminum is 500 feet per minute. D stands for the diameter of the cutter used.
4. Let's try a problem. We have a 1 inch cutter and we are cutting cold rolled steel. We will use the formula: $RPM = \frac{4 \times C}{D}$.
5. C is 100, which is the cutting speed of cold rolled steel. D is 1, which is the diameter of the cutter.
6. Let's plug in our known values, and solve the problem. $\frac{4 \times 100}{1} = \frac{400}{1} = 400$. We set our machine at 400RPM.
7. Let's try another problem. We have a $\frac{1}{2}$" cutter, and we are cutting cast iron. We use our formula, $RPM = \frac{4 \times C}{D}$. C, for cast iron, is 80. D is the diameter of our cutter, which is $\frac{1}{2}$. Now, we simply plug our known values into the formula and solve for the proper number of RPM's. $\frac{4 \times 80}{\frac{1}{2}} = \frac{320}{\frac{1}{2}}$. Remember, that $\frac{320}{\frac{1}{2}} = 320 \div \frac{1}{2}$. Now, simply invert the fraction $\frac{1}{2}$, and multiply. $320 \div \frac{1}{2} = 320 \times 2 = 640$. We set our machine at 640 RPM.

8. Now, you try to solve a problem. We have a 1 inch cutter, and we are cutting cast iron. How fast should we set the machine? Try to solve this problem before you go on.
9. If you did not get 320 RPM for an answer, see the teacher.
10. If you got 320 for an answer, go on to the Post Test.

POST TEST

1. How fast should you set a ½" cutter to cut a piece of aluminum?

2. How fast should you set a 2" cutter to cut cold rolled steel?

3. How fast should you set a 4" cutter to cut cast iron?

***** If you did not get 1000 for number 1, 200 for number 2, and 80 for number 3, see the teacher for some help. If all of your problems were correct, take your paper to the teacher.

FOR THE STUDENT

SOPHISTICATED MACHINES

CLIMB MILLING AND CONVENTIONAL MILLING

Objective:

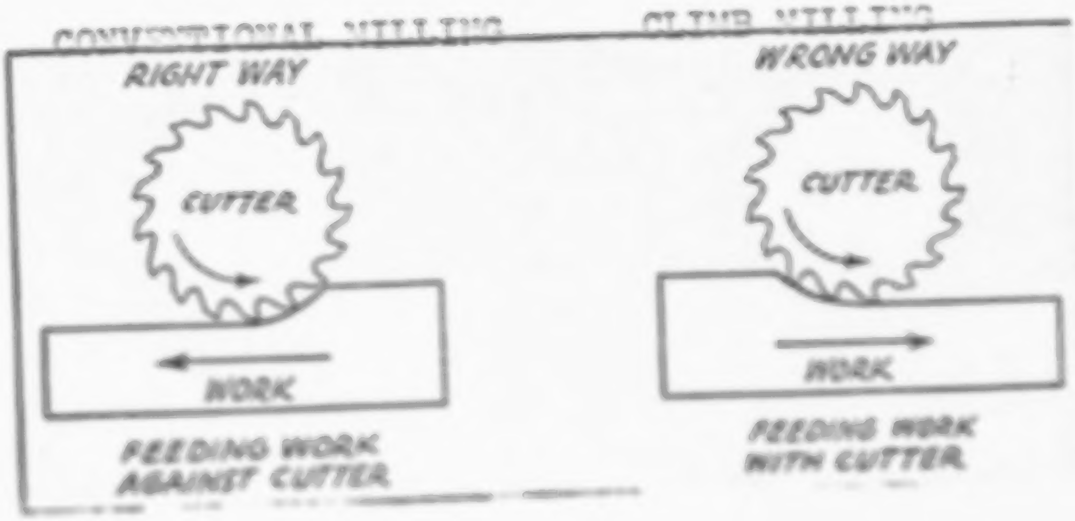
You will be able to define, in writing, the terms climb and conventional milling.

Prerequsite:

You must have completed packages J-13 and J-17

Activity:

1. While you are in a machine shop, you will ofter hear machinists talk about climb milling and conventional milling.
2. Climb milling means that the work is fed in the same direction as the cutter is revolving. This is very dangerous.
3. Conventional milling is when the work is fed against the rotation of the cutter. This is the proper way to mill stock on the machine.
4. Study the illustration below. This is a good illustration of the right and wrong way to feed the work.
5. In the figure, look at the illustration of climb milling. The teeth of the cutter will pull the work into it. Look at the point of the tooth just above the work. This tooth will begin to pull the work into it.


CONVENTIONAL MILLING
RIGHT WAY
CUTTER
WORK
FEEDING WORK AGAINST CUTTER
CLIMB MILLING
WRONG WAY
CUTTER
WORK
FEEDING WORK WITH CUTTER

5. cont. When this happens, the cutter will break almost every time. If the cutter breaks, a particle will come off as fast as a bullet travels. Obviously, you could get hurt or even killed if it hit you.
6. Look at the illustration of the conventional way. The teeth have a tendency to push the work away from the cutter. This is the right way to mill stock on the milling machine. If you use this method of checking the direction the work travel, you will never go wrong. Just remember that when you are climb milling, the teeth have a tendency to pull the work into the cutter. When you are conventional milling, the teeth have a tendency to push the work away from the cutter.
7. Take the Post Test.

POST TEST

1. What is meant by climb milling?

2. What is meant by conventional milling?

3. Which way of milling is the proper method?

****Take your paper to the teacher when you are finished.

FOR THE TEACHER

SOPHISTICATED MACHINES

SUGGESTED GUIDE FOR MILLING MACHINE DEMONSTRATION

Objective:

The student will be able to operate the milling machine in your shop.

Prerequsite:

The student must have completed packages J-13-J-18.

Activity:

Here is a suggested guide for your demonstration.

I. Safety talk.
  A. Proper dress.
  B. Everyone must have eye protection.
II. Insert cutter.
  A. Be sure cutter is tight.
III. Place stock in vice.
IV. Have the students calculate the correct RPM.
V. Have the students calculate the correct feed rate.
VI. Demonstrate the traverse and feed levers.
VII. Show the students how to set the speed and feed rates.
VIII. Show the students where the emergency stop button is located.
IX. Show the students how to operate the feed dials.
X. Show the students how the automatic feeds work.
XI. Start the spindle.
XII. Pick up the surface of the stock. (Preferably with a piece of tissue paper laid on the stock. When the cutter moves the paper, stop the spindle.
XIII. Move the cutter to the side of the stock.
XIV. Move down desired amount.
XV. Point out the difference between climb and conventional milling.
XVI. Start the machine again.
XVII. Let the stock feed across the cutter.
XVIII. Stop the machine.
XIX. Remove burrs.
XX. Remove stock from vice.
XXI. Clean the machine.

FOR THE STUDENT

SOPHISTICATED MACHINES

DIFFERENCES BETWEEN VERTICAL AND HORIZONTAL MILLING MACHINES

Objective:

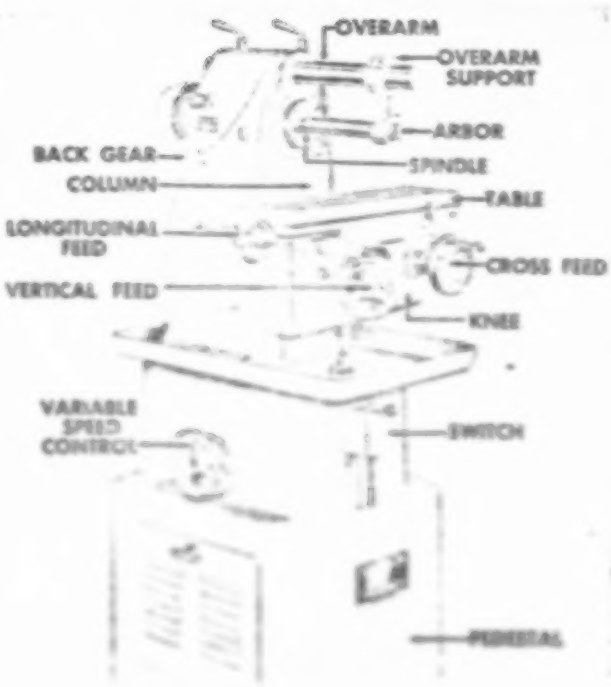
You will be able to list the five main differences between the vertical and horizontal milling machines.

Prerequsite:

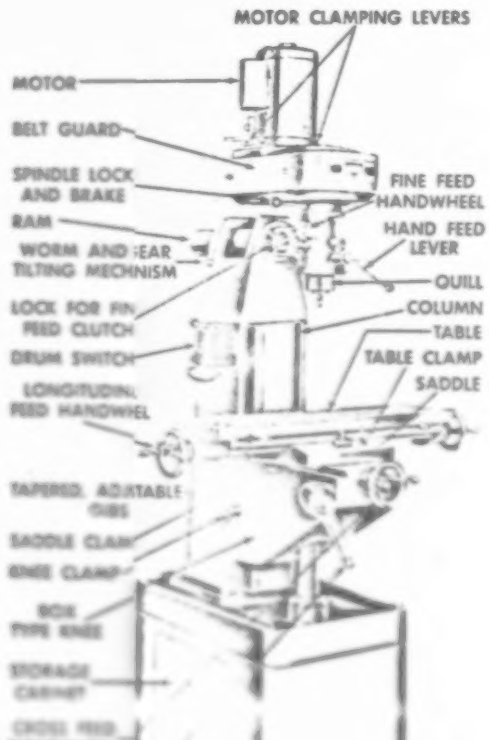
You must have completed packages J-13 and J-14.

Activity:

1. Pictured below are a vertical milling machine and a horizontal milling machine. Study the illustrations and proceed through the package.
2. The spindle in the vertical milling machine is in a vertical position.
3. The cutter on a vertical milling machine is held in a holder.
4. The spindle on a horizontal milling machine is in a horizontal position.
5. The cutter used on a horizontal milling machine is held on an arbor.
6. A horizontal milling machine has an overarm which supports the arbor, and a vertical milling machine does not.
7. When you know the five differences between the vertical and horizontal milling machines, take the Post Test.


OVERARM
OVERARM SUPPORT
ARBOR
BACK GEAR
SPINDLE
COLUMN
TABLE
LONGITUDINAL FEED
CROSS FEED
VERTICAL FEED
KNEE
VARIABLE SPEED CONTROL
SWITCH
PEDESTAL

THE HORIZONTAL MILLING MACHINE


MOTOR CLAMPING LEVERS
MOTOR
BELT GUARD
SPINDLE LOCK AND BRAKE
FINE FEED HANDWHEEL
RAM
HAND FEED LEVER
WORM AND GEAR TILTING MECHNISM
QUILL
LOCK FOR FINE FEED CLUTCH
COLUMN
TABLE
DRUM SWITCH
TABLE CLAMP
SADDLE
LONGITUDINAL FEED HANDWHEEL
TAPERED, ADJUSTABLE GIBS
SADDLE CLAMP
KNEE CLAMP
BOX TYPE KNEE
STORAGE CABINET
CROSS FEED HANDWHEEL
TABLE RAISING CRANK

THE VERTICAL MILLING MACHINE

POST TEST

Directions: List the five main differences between the Vertical and horizontal milling machines.

1.

2.

3.

4.

5.

**When you have listed the five main differences between the vertical and horizontal milling machines, take your paper to the teacher.

FOR THE STUDENT

SOPHISTICATED MACHINES

STUDENT LAB SHEET FOR BASIC MILLING MACHINE OPERATION

Objective:

Given a rectangular block of cold rolled steel and a properly equiped milling machine, you will be able to mill .050" off the top of the stock.

Prerequsite:

You must have completed packages J-13, 14, 15, 16, 17, and 20. You must also have attended the teacher's demonstration of the machine.

Activity:

1. Go to the stockroom and obtain a rectangular piece of cold rolled steel. (Approximately 1"X2"X2")
2. Go to the toolroom and get a 6" scale.
3. Place the stock in the vice of the milling machine so that the longest side of the stock is above the vice jaws.
4. Compute the feed rate, and set the machine correctly.
5. Compute the speed rate, and set the machine correctly.
6. Be sure you are dressed safely and you are wearing safety glasses.
7. Start the machine.
8. Pick up the surface of the stock, just like the teacher did in the demonstration.
9. Move the cutter to the side of the stock.
10. Be sure you are not climb milling.
11. Move down .050".
12. Engage the feed lever.
13. Let the stock feed across the cutter.
14. Stop the feed.
15. Stop the machine.
16. Remove the stock and file the burrs off the stock.
17. Clean up the machine.
18. Take your stock to the teacher.

No. J-110

FOR THE STUDENT

SOPHISTICATED MACHINES

INTRODUCTION TO THE VOLT-OHM-MILLIAMMETER (VOM)

Objective:

Given three (3) electronics catalogs (Allied Radio, Heath Company, Radio Shack, Lafayette, etc.), one completed VOM Data Sheet (see attached sample), and three blank VOM Data Sheets, you will complete all three blank sheets as specified, using a different catalog and manufacturer for each sheet.

Activity:

1. Fill in your name and the date in the space provided on the data sheet.
2. List the name of the catalog you are using. Use a separate data sheet for each catalog.
3. Using the catalog INDEX, look up a Volt-Ohm-Milliammeter and list the pages that you will use. (An Index is like a table of contents. It tells you where to find something in the catalog. The index is arranged alphabetically.)
4. List the name of the company that manufactures the meter. Each sheet should have a different manufacturer.
5. List the model number of the meter you are describing
6. List the price of the meter.
7. Read the "Description of a VOM" on your data sheet.
8. List the greatest amount of Direct Current (D.C.) Volts, Alternating Current (A.C.) Volts, Resistance (Ohms, Ω), and Current (Amps) that the VOM you are describing measures.

No. J-110

SAMPLE VOM DATA SHEET

Student Name ____________ Date ____________

Name of Catalog ALLIED RADIO

Page Number 276

Name of VOM Manufacturer SIMPSON

VOM Model Number 260-5 VOM

Price $ 62.00

DESCRIPTION OF A VOM

The Volt-Ohm-Milliammeter (VOM) is one of the most important electrical test instruments used by the Electronics Technician and Radio-television Repairman. The name, Volt-Ohm-Milliammeter tells you that this instrument measures VOLTS (A.C. & D.C.), OHMS (resistance), and Milliamps (current). Some VOM's also measure larger amounts of current in amperes.

Direct Current (D.C.) Volts 5000 V.D.C.

Alternating Current (A.C.) Volts 5000 V.A.C.

Resistance (Ω) 20 MEGS Ohms (Ω)

Current (amps or milliamps) 10 AMPS

or ____________ Milliamps (Ma)

No. J-110

VOM DATA SHEET

Student Name ______________________ Date ______________________

Name of Catalog ______________________

Page Number ______________________

Name of VOM Manufacturer ______________________

VOM Model Number ______________________

Price ______________________

DESCRIPTION OF A VOM

The Volt-Ohm-Milliammeter (VOM) is one of the most important electrical test instruments used by the Electronics Technician and Radio-television Repairman. The name, Volt-Ohm-Milliammeter tells you that this instrument measures VOLTS (A.C. & D.C.), OHMS (resistance), and Milliamps (current). Some VOM's also measure larger amounts of current in amperes.

Direct Current (D.C) Volts ____________ V.D.C.

Alternating Current (A.C.) Volts ____________ V.A.C.

Resistance (Ω) ____________ Ohms (Ω)

Current (amps or milliamps) ____________ AMPS

or ____________ Milliamps (Ma)

FOR THE STUDENT No. J-120

SOPHISTICATED MACHINES

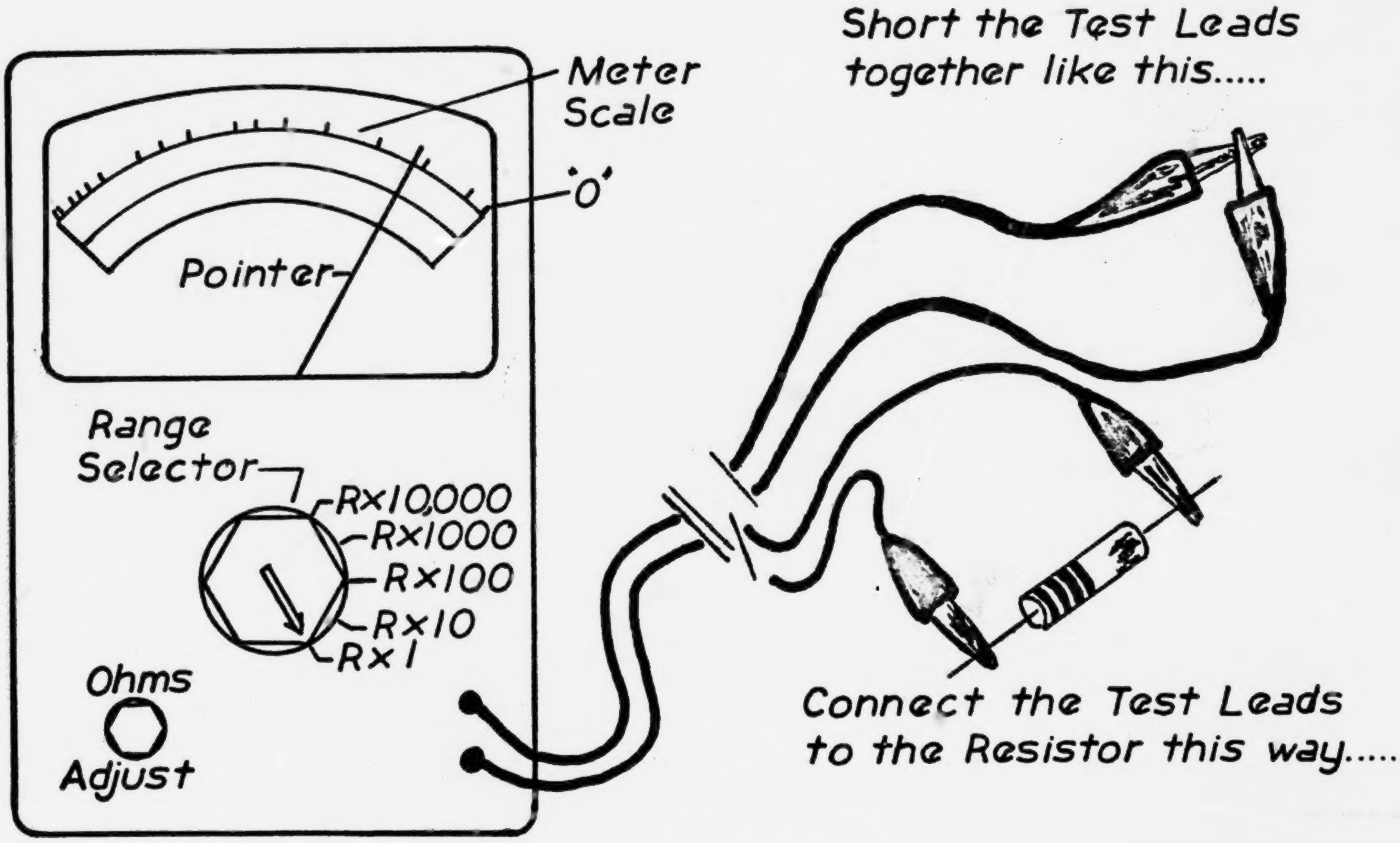
THE OHMMETER: MEASURING RESISTORS

Objective:

Given an ohmmeter and five (5) resistors of unknown value, you will determine, within ±20%, the value of all five resistors and record these values on the work sheet.

Activity:

1. Set the range selector on the ohmmeter to the lowest range. If your meter reads R x 1, R x 10, R x 100, and R x 1000, the lowest range is R x 1.
2. Short the "test leads" by touching them together.
3. With the test leads shorted, adjust the "ohms adjust" control until the pointer on the meter reads 0 on the scale.


Meter Scale
'0'
Pointer
Range Selector
R×10,000
R×1000
R×100
R×10
R×1
Ohms Adjust

Short the Test Leads together like this.....

Connect the Test Leads to the Resistor this way.....

4. Connect the test leads to the first resistor.

5. On the scale, read the number directly under the pointer. If the range selector is set at R x 1, multiply the number by 1. If the range selector is set at R x 10, multiply the number by 10. Study the examples below.

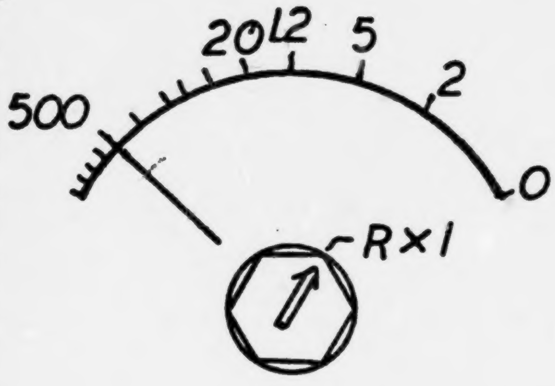
   RULE: Remember to always multiply the number on the scale by the setting of the range selector.

   This gives you the value of the resistor in OHMS.

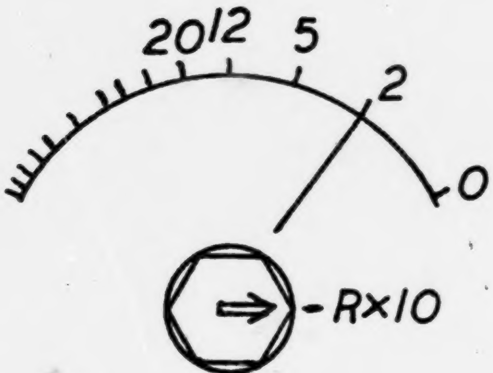
6. Record the resistor value on the work sheet.

7. If the pointer does not move, or moves very little, set the range selector to the next higher range, and repeat steps 2,3,4,5, and 6 above.

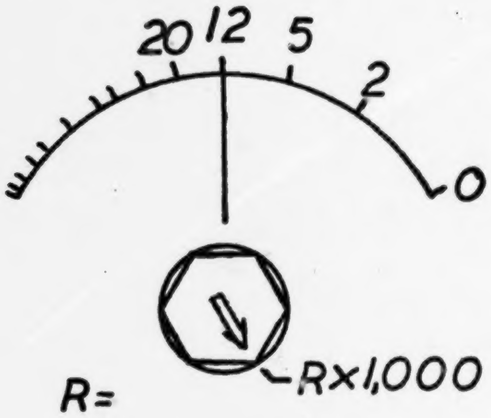
   RULE: Remember to always readjust the "Ohms Adjust" control when setting the range selector to another range.



R = 500×1 = 500 Ohms



R= 2×10 = 20 Ohms



R= 12×1,000= 12,000 Ohms

STUDENT WORK SHEET

Name____________________

A =________________Ohms

B =________________Ohms

C =________________Ohms

D =________________ohms

E =________________Ohms

No. J-120

TEACHER'S REFERENCE INFORMATION FOR STUDENT PACKAGE

Media:

For this package the student will need:

Five resistors, ±5%, labled A,B,C,D, and E. (If possible, select resistor values that will directly correspond to whole numbers on the meter scale.)

Ohmmeter or Volt-Ohm Meter (VOM). (Preferably with three or more resistance ranges.)

Test leads with Alligator Clips.

FOR THE STUDENT

No. J-130

SOPHISTICATED MACHINES

THE VOLT-OHM-MILLIAMMETER (VOM)

USED AS A DIRECT CURRENT (D.C.) VOLTMETER

Objective:

Given a Volt-Ohm-Milliammeter (VOM), a set of test leads (one red, one black), and five (5) batteries of unknown value (labeled #1, 2, 3, 4, and 5), you will measure the Direct Current (D.C.) voltage of each of the five batteries (±10%) and record the voltage of each battery in the proper space on the D.C. Voltmeter Data Sheet.

Prerequisite:

You must have completed package No. J-110.

Activity:

1. Fill in your name and the date in the space provided on the Data Sheet.

2. Look at the METER SCALE on your VOM. On most VOM's the D.C. voltage scale is printed in black. On the scale below (see figure 1) the scale reads from 0-250, from 0-50, and from 0-10. What does the D.C. scale on your VOM read? Answer here: __________, __________, __________, __________.

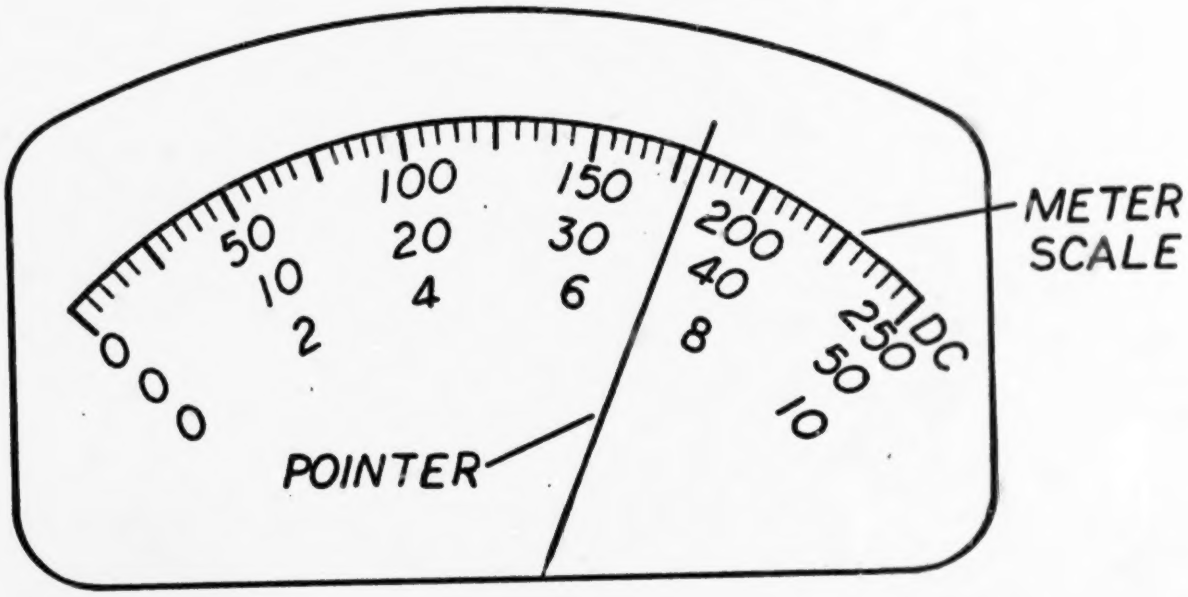


FIGURE 1.

3. If the RANGE SELECTOR is set at 250 V.D.C. and the POINTER is at 150 on the scale, the voltage being measured is 150 volts D.C. (see figure 2).

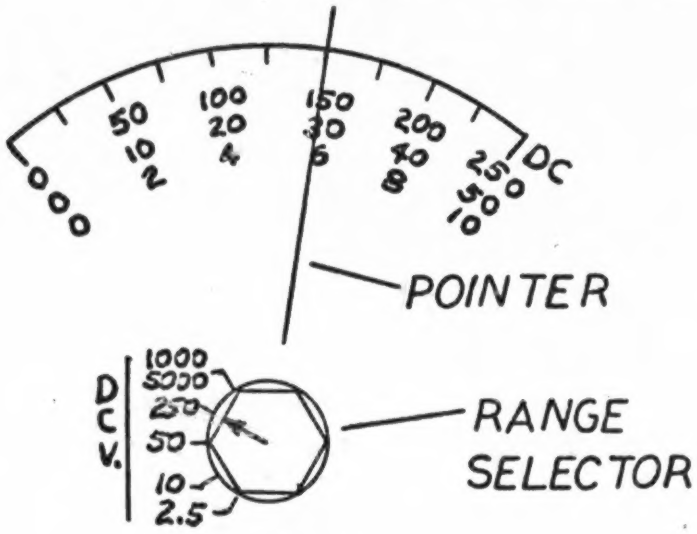

0 0 0
50 10 2
100 20 4
150 30 6
200 40 8
250 50 10
DC
POINTER
D C V.
1000
5000
250
50
10
2.5
RANGE SELECTOR

FIGURE 2.

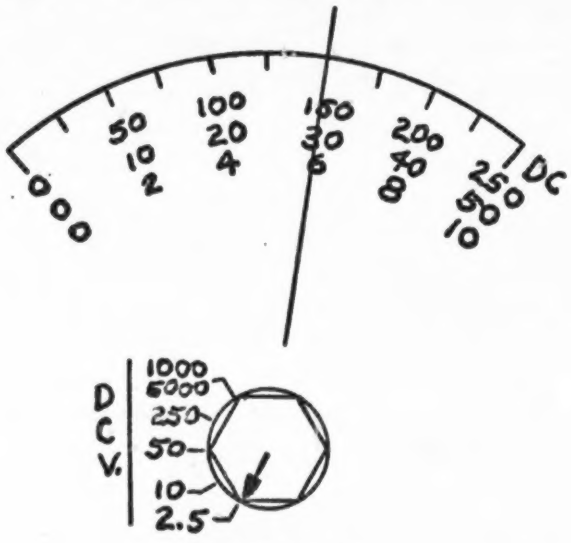

0 0 0
50 10 2
100 20 4
150 30 6
200 40 8
250 50 10
DC
D C V.
1000
5000
250
50
10
2.5

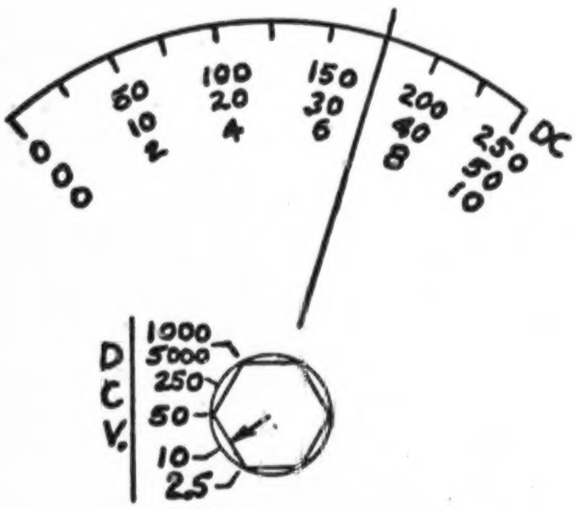
FIGURE 3.

But if the RANGE SELECTOR is set at 2.5 V.D.C., and the POINTER is at 150 on the scale, the voltage being measured is 1.5 volts D.C. (see figure 3).

RULE: The setting of the RANGE SELECTOR indicates the highest voltage that you can measure using that range.

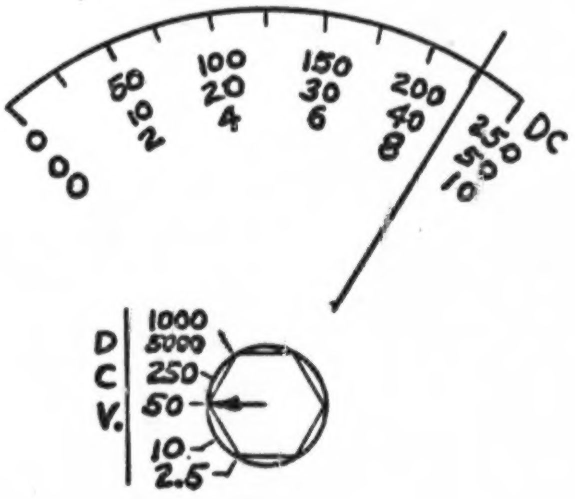
4. Study the problems in figure 4. From the setting of the RANGE SELECTOR and the position of the POINTER, what is the D.C. voltage being measured in each problem? Put your answer for each problem in the space provided below the problem.

FIGURE 4


0 0 0
50 10 2
100 20 4
150 30 6
200 40 8
250 50 10
DC
D C V.
1000
5000
250
50
10
2.5

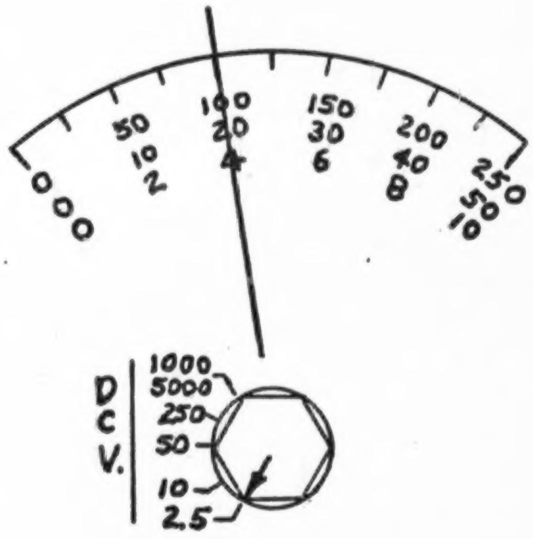
Problem #1 =

______Volts D.C.


0 0 0
50 10 2
100 20 4
150 30 6
200 40 8
250 50 10
DC
D C V.
1000
5000
250
50
10
2.5

Problem #2 =

______ Volts D.C.


0 0 0
50 10 2
100 20 4
150 30 6
200 40 8
250 50 10
D C V.
1000
5000
250
50
10
2.5

Problem #3 =

______Volts D.C.

5. Check your answers to Problems #1, #2, and #3 with the correct answers at the bottom of page 4.

6. Insert the TEST LEADS in the proper INPUT JACKS on the VOM (see figure 5). The RED TEST LEAD belongs in the INPUT JACK marked (+) or (V-Ω-A) or (+DC). The BLACK TEST LEAD belongs in the INPUT JACK marked (-) or (COMMON) or (COM).

7. Set the RANGE SELECTOR on the VOM to the highest Direct Current (D.C.) voltage range. Usually this range is marked 1000V/5000V, (see figure 5).

RULE: When measuring an unknown voltage, FIRST AND ALWAYS set the VOM to its highest voltage range.

8. If your VOM has a FUNCTION SWITCH (see figure 5), set it to the (+DC) position.

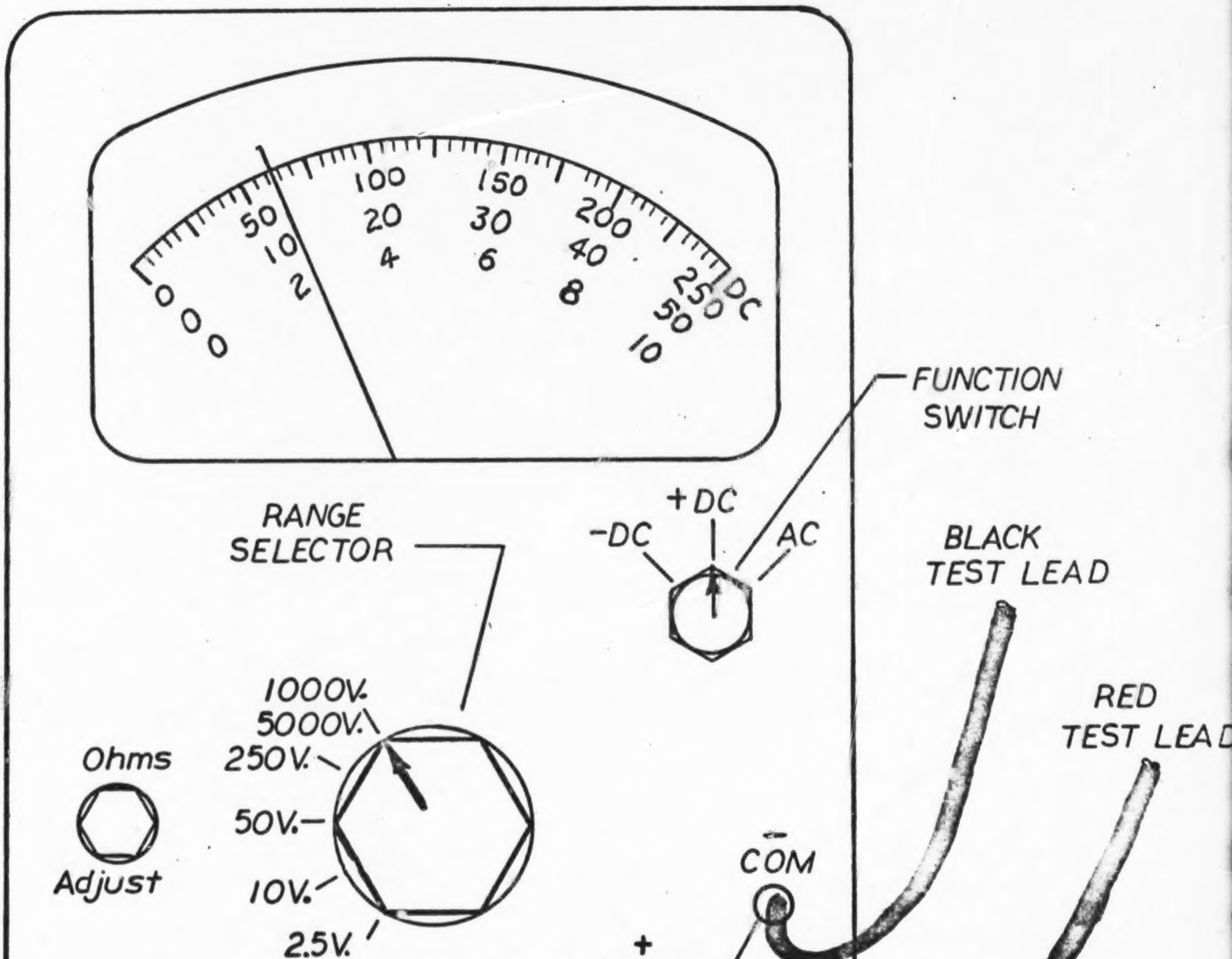

100
150
50
200
20
30
10
40
4
6
250
DC
2
8
0
0
0
50
10
FUNCTION
SWITCH
+DC
RANGE
SELECTOR
-DC
AC
BLACK
TEST LEAD
RED
TEST LEA
1000V.
5000V.
Ohms
250V.
50V.
Adjust
10V.
2.5V.
-
COM
+
V-Ω-A
INPUT
JACKS

FIGURE 5.

9. Before you measure the voltage of the batteries, read steps 10, 11, 12, 13, 14, 15, and 16 to become familiar with the procedure.

10. Connect the BLACK TEST LEAD (-) to the negative (-) terminal of one of the batteries.

11. Connect the RED TEST LEAD (+) to the positive (+) terminal of the battery.

12. If the POINTER moves to the left, QUICKLY DISCONNECT the battery and check to see if you have correctly followed steps 6, 8, 10, and 11, above.

13. If at any time the POINTER moves all the way to the right, QUICKLY DISCONNECT the battery. Switch the RANGE SELECTOR to the next higher range, and reconnect the battery.

14. Read the voltage indicated on the scale. If the voltage is more than the next lower range will measure, record the voltage in the proper space on the D.C. Voltmeter Data Sheet.

15. If the voltage indicated on the scale is less than the next lower range will measure, switch the RANGE SELECTOR to that lower range. Repeat this step until you are measuring the battery voltage on the lowest possible range without causing the POINTER to move all the way to the right.

16. Read the voltage indicated by the POINTER on the scale. Record this voltage in the proper space on the D.C. Voltmeter Data Sheet.

17. Follow the above steps (10-16) to measure the voltage of the remaining batteries.

Answers to step 4: Problem #1 = 7 Volts D.C.
Problem #2 = 45 Volts D.C.
Problem #3 = 1 Volt D.C.

D.C. VOLTMETER DATA SHEET

No. J-130

Student Name________________________________ Date______________

BATTERY	MEASUREMENT
#1.	____________ Volts D.C.
#2.	____________ Volts D.C.
#3.	____________ Volts D.C.
#4.	____________ Volts D.C.
#5.	____________ Volts D.C.

TEACHER REFERENCE INFORMATION FOR STUDENT PACKAGE No. J-130

SOPHISTICATED MACHINES

THE VOLT-OHM-MILLIAMMETER (VOM)
USED AS A DIRECT CURRENT (D.C.) VOLTMETER

For this package the student will need:

1. A Volt-ohm-milliammeter (VOM)
2. A set of test leads, (one red, one black) with alligator clips.
3. Five batteries of the following suggested values:

   1.5 V. Size D

   1.5 V. Size AA

   6.0 V.

   9.0 V.

   45.0 V.

4. The batteries should be labeled #1, #2, #3, #4, and #5 (in any order) so that the value printed on the battery cannot be seen. Be sure that the battery terminals are appropriately labeled (+) and (-).
5. When checking the voltages measured by a student, note that the actual battery voltage often differs from its voltage rating.
6. A blank D.C. Voltmeter Data Sheet.

FOR THE STUDENT No. J-200

SOPHISTICATED MACHINES

INTRODUCTION TO THE CATHODE RAY OSCILLOSCOPE

Objective:

Given three electronics catalogs (Allied Radio, Heath Company, Radio Shack, Lafayette, etc.), one completed Oscilloscope Data Sheet, and three blank Oscilloscope Data Sheets, you will complete all three blank sheets as specified, using a different catalog and manufacturer for each sheet.

Activity:

1. Fill in your name and the date in the space provided on the data sheet.
2. List the name and number of the catalog you are using. Use a different catalog for each data sheet.
3. Using the catalog INDEX, look up a General Purpose Oscilloscope. (An INDEX is like a table of contents. It tells you where to find something in the catalog. The INDEX is arranged alphabetically.) Look under "Oscilloscope" or "Test Equipment." List the page number that you will use.
4. List the name of the company that manufactures the Oscilloscope.
5. List the model number of the oscilloscope.
6. List the price of the oscilloscope.
7. Read the "Description of an Oscilloscope" on page 2 and 3.
8. List the size of the Cathode-Ray Tube. This is usually the size of the screen. Often this number is given in the title of the description in the catalog.
9. Read the description of the Oscilloscope in the catalog.
10. List the Vertical and Horizontal Frequency Range of the Oscilloscope. This may be listed under the part describing the "vertical channel," or Vertical Input and the "horizontal channel" or Horizontal Input.
11. List the Frequency Range of the Horizontal Sweep Generator.

DESCRIPTION OF AN OSCILLOSCOPE

An Oscilloscope is a very ACCURATE and useful electronic tool. It measures voltage and frequency. The Oscilloscope uses a Cathode-Ray Tube (CRT) to show the amount of voltage it is measuring on a SCREEN. The CRT is something like the picture tube in a television receiver. Study the picture of a CRT in Figure 1. Note the names of some of the most important parts.

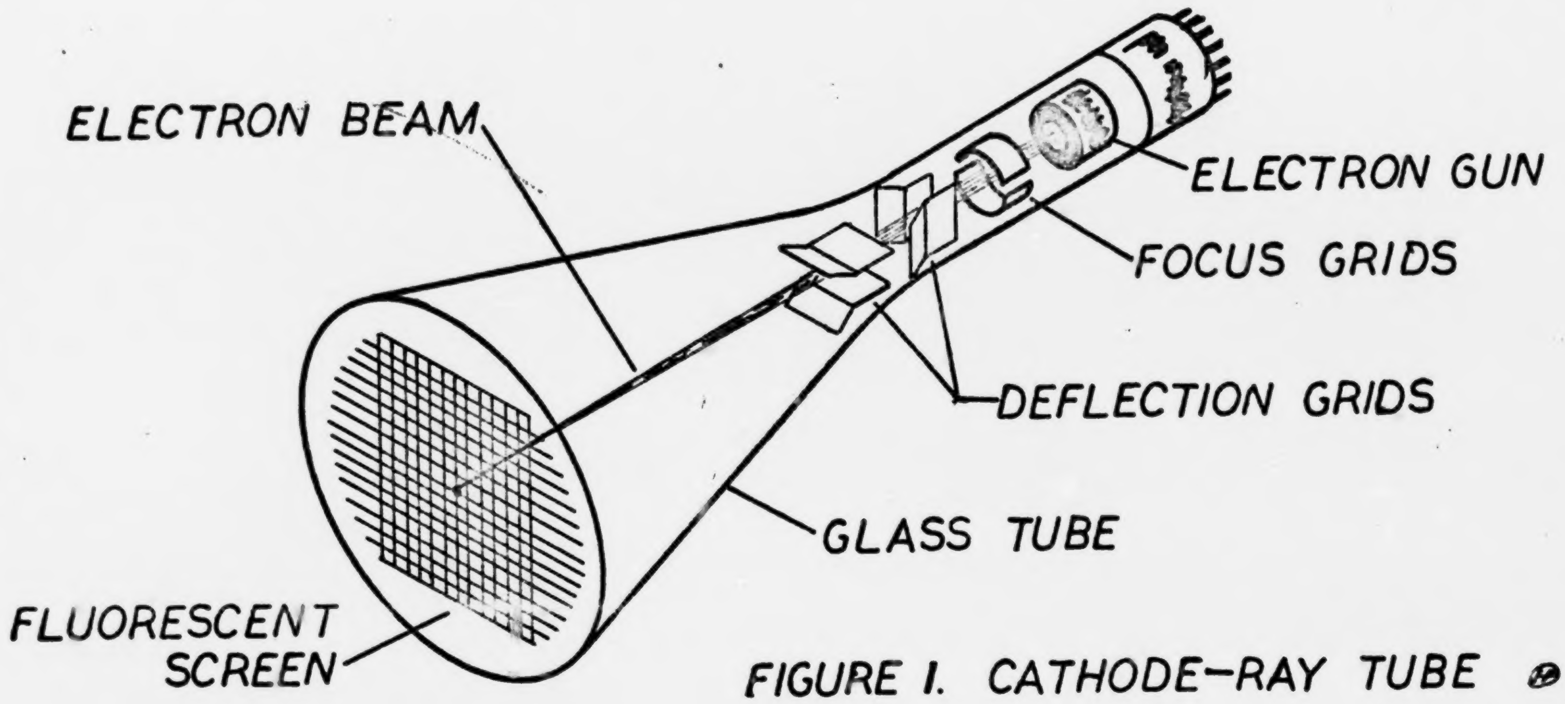


FIGURE I. CATHODE-RAY TUBE

The CRT is a glass tube shaped like a cone. At one end it has an ELECTRON GUN which shoots a beam of electrons at a FLUORESCENT SCREEN. When the electrons hit the screen, they cause the fluorescent material to give off light. The Oscilloscope can FOCUS the electrons into a small beam so that a small point of light can be seen on the screen. It also has DEFLECTION GRIDS which cause the ELECTRON BEAM to hit different places on the screen.

When you use the Oscilloscope to measure a voltage, you cause it to move the electron beam up or down and from one side to the other. If you are measuring a small voltage, the electron beam moves only a little. If you are measuring a large voltage, the electron beam moves a lot. Since you can see how much the point of light moves, you can tell how much voltage you are measuring.

The Oscilloscope also has a circuit which automatically moves the electron beam from left to right (horizontally) across the screen. This circuit is called the HORIZONTAL SWEEP GENERATOR. It can be adjusted to move the electron beam across the screen at different speeds (frequency). By matching the speed of the Horizontal Sweep Generator to the voltage that that you are measuring, you can determine the frequency of that voltage.

No. J-200

SAMPLE OSCILLOSCOPE DATA SHEET

Student Name____________________ Date________

Name of Catalog HEATHKIT

Number of Catalog 810/70D

Page Number 57

Name of Manufacturer HEATH COMPANY

Model Number IOW-18

Price $ 164.95

Size of Cathode-ray Tube (CRT) 5"

Frequency Range (Vertical) 3HZ — 5MHZ

Frequency Range (Horizontal) 1HZ — 400KHZ

Horizontal Sweep Generator Range 10HZ — 500KHZ

No. J-200

OSCILLOSCOPE DATA SHEET

Student Name_____________________________ Date____________

Name of Catalog ______________________

Number of Catalog ______________________

Page Number ______________________

Name of Manufacturer ______________________

Model Number ______________________

Price $_____________________

Size of Cathode-Ray Tube (CRT) ______________________

Frequency Range (Vertical) ______________________

Frequency Range (Horizontal) ______________________

Horizontal Sweep Generator Range ______________________